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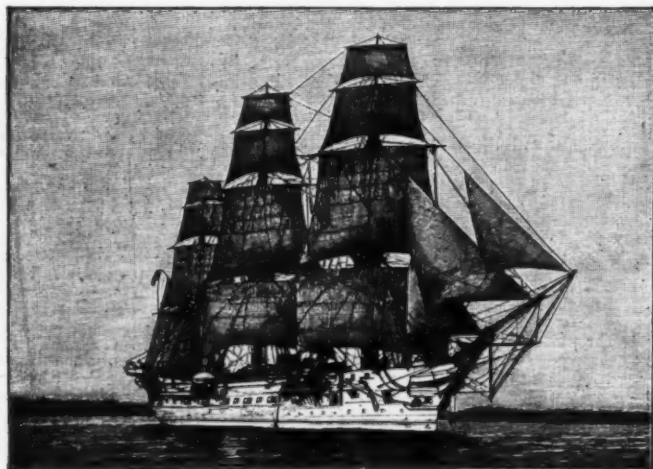
### LIFE OF NAVAL CADETS AND APPRENTICES ON THE GERMAN SCHOOLSHIPS.—I.

#### SAIL MANEUVERS.

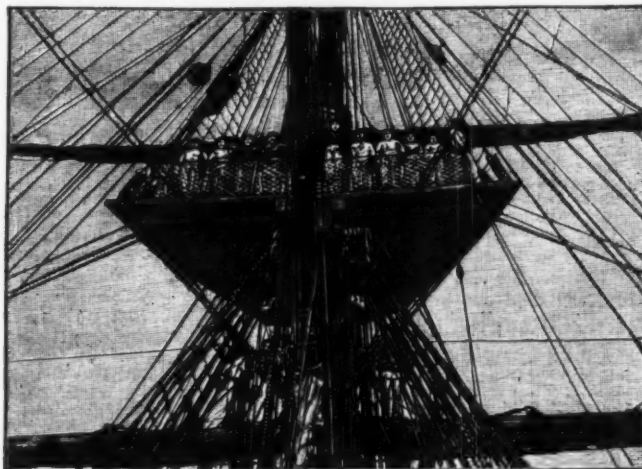
How the naval cadets, apprentices and sailors run and climb into the rigging, pull and haul, veer and luff, all at once when "all hands" is piped! Then the heart of the true seaman beats with the furor maritimus, his feet seem to have wings and he braces body

and mind for hazardous deeds. There is nothing more interesting and beautiful in all the naval maneuvers than the sail drill. Everything is done with the greatest quiet, for there is no calling or shouting, the "mast officers" and their subordinates are allowed only signs and gestures. The command of the officer on the bridge sets the whole sail mechanism in operation, hundreds of strong hands move busily and quickly on the deck, in the rigging and on the yards,

and feet fly over the deck, up the masts and out on the yards. Nothing so strengthens a man, at the same time making him agile and supple, nothing trains him to quick, bold action, awakens his courageous self-reliance, nor gives a better understanding of the necessity of perfect subordination to and co-operative work under one ruling mind for the welfare of all, like well-conducted sail maneuvers carried out without haste or confusion. The man on the yard knows



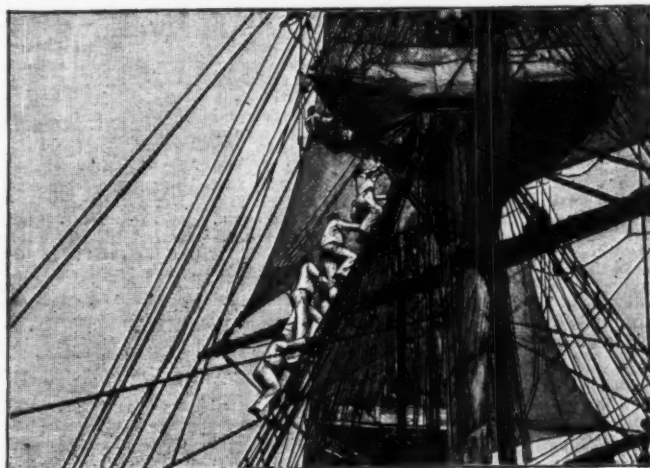
S. M. SCHOOLSHIP "GNEISENAU" UNDER SAIL.



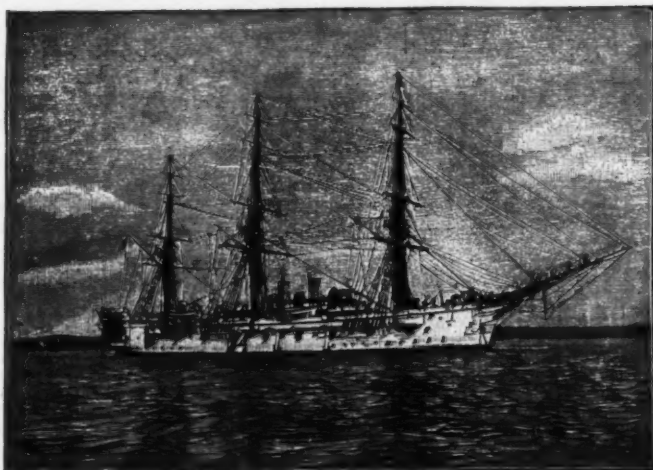
CREW ON YARD.



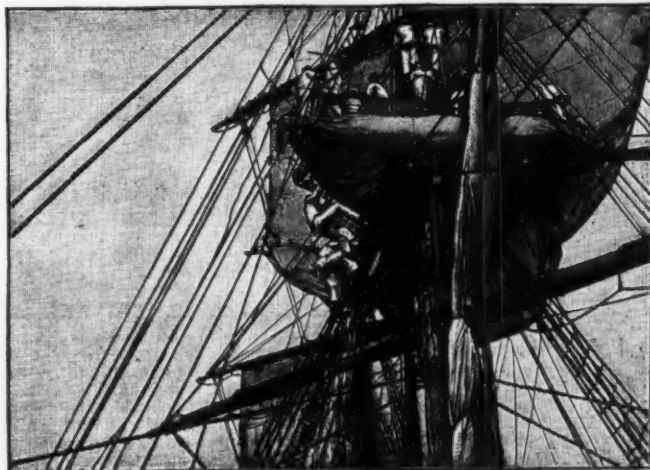
CADETS ON THE JACOB'S LADDERS.



CADETS IN THE SHROUDS.



S. M. SCHOOLSHIP "CHARLOTTE"—CADETS STARTING ALOFT.



IN THE FUTTOCK SHROUDS.

LIFE OF NAVAL CADETS AND APPRENTICES ON THE GERMAN SCHOOLSHIPS.



that he must work hand in hand with his comrades, and he also knows his dependence on his comrades on the deck, for if they should not do their work at just the right moment they might pull him from his perch, and he also understands that the practiced eye of the commander is needed to guide everything on deck and in the rigging.

When the order "Clear for practice" sounds through the vessel, the lower decks are cleared in a few minutes and "all hands" are at their proper stations, in groups; the men wearing one or two red stripes on their right sleeves (the first and second divisions of the starboard watch) stand on the starboard side, and the port watch, consisting of men wearing one and two stripes on the left sleeves, stands on the port side. At the mizzenmast are the quarter-deck men, at the mainmast is the aft crew, at the foremast the crew for the waist,

given. They are not kept waiting: "Top over" is heard from below, and in an instant all is life on the yards. Leaning far forward, with feet on the horses (ropes under the yards for foot rests), they loosen the lashings, but still hold the unfurled sail until the command "Let fall!" reaches them. As soon as the sails have been allowed to fall, the yard crews "lay in" and return to the deck or to the tops, while the deck crews pull and haul the sails out on the clews, and hoist the yards so that the sails stand stiff, until all the sails and yards are braced. How long has all this taken?—ten minutes, a quarter of an hour? No, indeed! In two minutes and eighteen seconds all the sails are ready to let loose, and with the same rapidity the sails are brailled up from the deck and secured on the yards.

All sail maneuvers can be carried out by half the

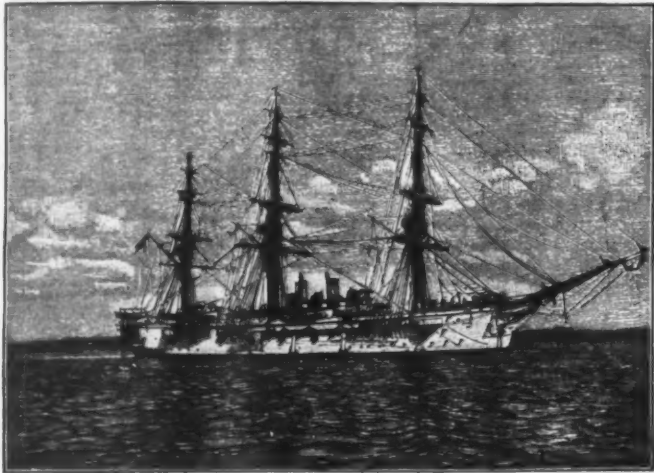
Jorgensen of 1808 penetrated 26-125 inches, while the Springfield could send a bullet only 6 inches through the same thickness of wood. The velocity of a bullet expelled from a Lee-Metford is nearly equal to that of one from a Mauser. What, then, are the consequences and nature of an injury produced by a bullet traveling at such a marvelous speed? Brun's experiments led him to believe that at ranges over three hundred meters the small caliber bullet hardly ever becomes deformed, while between four hundred and fifteen hundred meters it, as a rule, makes a wound with a very small passage, with very small apertures at the points of ingress and egress and with very little shattering of bones or tearing away of the soft parts. Stevenson says the velocity of the bullet since 1865 has greatly increased, and, consequently, in the same ratio, its energy or impact. With increased velocity they have gained enormously in penetration, but if they do not reach a vital part or strike a large bone, they do not disable. With respect to the character and gravity of a wound, the same authority remarks: "When a bullet has passed through soft parts only, the exit wound is usually a circular punctured-out hole, but its edges are slightly shreddy and torn. . . . The nearer the bullet strikes the bone at its greatest diameter, the greater is the destruction produced, both in the bone and in the soft parts beyond; but even with grazing shots, most severe splintering of the bone and extensive pulping of the soft parts are observed."

Dr. Davis, speaking from his experience in the Greco-Turkish war, reaches the conclusion that the initial force of a bullet is an onward or penetrative one; that when penetration is impeded, the onward force becomes transformed into a lateral one; that explosive effect is only another name for lateral action, i. e., outside the track of the bullet; that lateral action is most marked in hard bones (the fragments being carried onward) and in organs containing water (bladder, brain, liver, etc.); that practically the rotation of the bullet on its axis does not materially affect the character of the injury; that the effect of gunshot wounds is not so severe upon the living body as upon the dead; that the destructive power of the small caliber gun has been overestimated; that its stopping or disabling power is less than that of larger calibers; that wounds in future conflicts will be, as a rule, less severe and will heal more rapidly, with fewer complications, than has been the case in the past; that less radical treatment will be required, and conservatism will be followed by brilliant results.

The foregoing views have been quite recently corroborated in many respects by the army surgeons in the Philippines. Surgeon Beck, of the Thirtieth Minnesota, says that "to the small caliber bullet of the insurgents' Mausers the wounded boys owe their lives and a continuance of their usual friendly association with good arms and legs. In the bony structure of the body the Mauser bores a clean little hole, rarely fracturing a limb; in the skull it takes a center shot to kill."

He says that he has knowledge of fully a hundred men shot through the chest cavity in every portion except the heart who recovered. But while the injuries brought about by bullets from the army rifles of to-day are, on the whole, less severe than was formerly the case, abdominal wounds are as fatal, if not more so, than in former times. Surgeon Beck says: "Through the soft abdominal tissues the Mauser is always fatal. Wounds of the intestines, stomach, and spleen always kill. Every operation for resection of wounded intestines resulted in death, and the operation is now entirely abandoned."

This is in line with the opinion of a large number of army surgical authorities, although views differ considerably as to whether, in penetrating wounds of the abdomen, a radical or conservative treatment should be pursued. Dr. William Parker, of New Orleans, discussing this point, records his belief that in abdominal wounds caused by the small modern bullet laparotomy should not be attempted in the field. Dr. Nicholas Senn lays down the dictum that laparotomy, in pene-



S. M. SCHOOLSHIP "CHARLOTTE"—CADETS ON YARDS.

and on the port side the port crew. They had to take charge of the "ends" on deck which set yard, sail and topmast in motion.

The men for the yards, who have taken their places by their respective masts, are called aloft, their leaders and officers being cadets (ensigns, for example) and under-officers.

The "mast officer," with his wonder-working apparatus by means of which he signals his orders, the signal flag in hand, musters his division quickly, tells at a glance whether his belaying pin racks are in order and whether the rope ends are clear for casting loose, charges the men at the stopper and bits to be on the watch, and then waits with his crew, not entirely free from anxiety and excitement, the commands from the bridge to the masts which will open the contest.

The cadets and under-officers, as leaders of the yard crews, start first, and they have scarcely left the deck when the command, "Mast crews, topgallant yard and royal yard crews of both watches, aloft!" sounds from the bridge. The mast crews are trusted with the most difficult posts and troublesome work in the highest and farthest places. They climb boldly and nimbly and wait in the tops for the rest of the crew to rush to a common struggle on the yards and topmasts. "Set all sails!" sounds over the deck, and this command is followed by "Loose sails!" which is the signal that electrifies all of the yard men who are still below

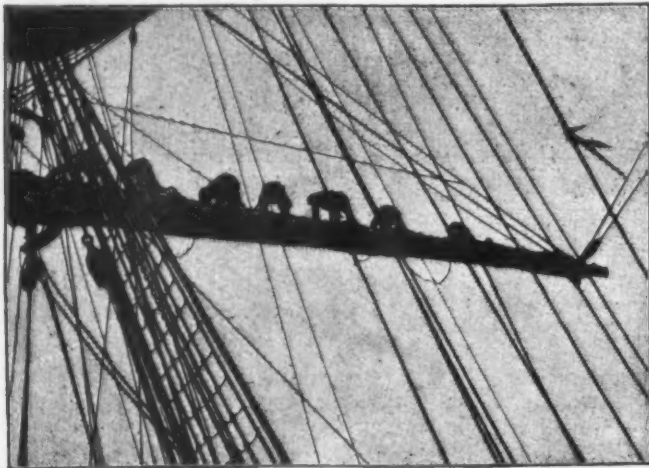
number of men called out by the order for "all hands"; that is, by either the starboard or the port watch alone; and this drill is of the utmost importance for real practical work on the high seas. Only one watch is at the command of the officer of the watch, day or night, and the order "all hands," which can be given only with the consent of the commander, sets the entire ship in commotion, especially on a stormy night. Whenever it is possible the officer of the watch tries to save his men—never robbing them of a night's sleep unnecessarily—by carrying out the maneuvers with half of his watch. This must also be practiced so that the same maneuver can be performed in several different ways.

We are indebted to Ueber Land und Meer for the engravings and the information from which we have prepared our article.

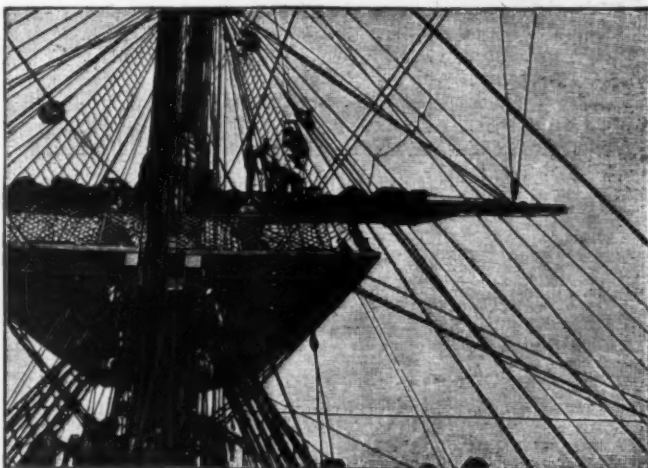
(To be continued.)

#### BULLET WOUNDS IN MODERN WARFARE.

It is safe to say that since the introduction of the small caliber rifle and smokeless powder the conditions of warfare have undergone an almost complete change. Until our war with Spain little was definitely known of the effects produced by wounds resulting from a bullet fired from a modern rifle. Indeed, with the exception of the experience of the British gained in Indian frontier wars, our knowledge in regard to the



ON THE YARD.



LOOSENING THE SAIL.

#### LIFE OF NAVAL CADETS AND APPRENTICES ON THE GERMAN SCHOOLSHIPS.

and they rush to the Jacob's ladders, short stationary ladders leading from the deck to the shrouds, to be ready for the command "Aloft!" which starts them in the greatest haste up the ladders into the shrouds, no one paying attention to the heads, ribs, hands or feet of the men above, below or beside him, for the man who does not push forward will be left far behind. In the lower shrouds there are forty rattlings (steps) and in the futtock shrouds (which slant to the topmasts) prudence orders a slower gait, but still the one thought of each man must be "forward," "forward," until the tops are reached and a new command is

latest patterns of small arms may be said to have been practically nil. Much valuable information was gathered during the fighting in Cuba. And the battles and skirmishes now continually taking place in Luzon will undoubtedly furnish further and more precise evidence in regard to the comparative deadliness of the old and new weapons and to the difference in the character of the injuries inflicted by them. The Filipinos, as were the Spanish, are chiefly armed with the Mauser, an excellent type of the up-to-date rifle. The penetrating power of the Mauser bullet of the pattern of 1897 is, according to Major Legarde, 35-125 inches. The Krag-

trating gunshot wounds of the abdomen, is indicated in all cases in which life is threatened by hemorrhage of visceral wounds, and the general condition of the patient is such as to sustain the expectation that he will survive the immediate effects of the operation. And Sir William MacCormac advises, when penetration has been diagnosed, that abdominal section should be performed as quickly as possible. The fact, however, may be noted here that the mortality which has up to the present followed penetrating wounds of the abdomen treated on the battlefield or in war hospitals has been extremely high. The French lost 91-7 per

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cent. of their cases in the Crimea and the English 92's per cent. In the American war the death rate was 90 per cent. From a consideration of the facts arrived at in regard to the bodily damage inflicted by the small caliber bullet in the Spanish-American, Greco-Turkish, Philippine, and Indian frontier wars these conclusions may be laid down:

That while the modern army firearm leaves nothing to be desired as a humane weapon, it hardly fulfills the special purpose for which it has been designed.

That owing to the velocity with which the bullet of a modern rifle travels, there is but little fear of pieces of clothing being carried into the wound, and, in consequence, the danger of infection by these means is very considerably reduced.

That the wounds produced are, as a rule, much less serious than when bullets of a larger caliber are used. That the velocity of a bullet fired from any one of the new rifles is so great that it does more damage at a distance than at close quarters.

And, lastly, that abdominal wounds effected by bullets fired from weapons of the newest type are in a high degree fatal.—Medical Record.

#### THE TRAINING OF A MODERN CAVALRY-MAN.

The training of an infantryman in a European army is essentially the training of a man; but the training of a cavalryman is the training of a man and of a horse. To teach a foot-soldier how to use his arms, how to act with his fellows, to receive commands, and to obey them intelligently, is not the easiest task in the world; but how much more difficult must it be to convert a horse from a purposeless, thoughtless animal into an active factor in a great fighting organism.

The stern requirements of modern military education

signated by the phrases mentioned are not states made up of such a feeling of incompetency, but are very complex affairs; and third, that these mental states are in no sense parallels or measures of the decrease in ability to do mental work.

We have been accustomed to think of mental work in terms of mechanics. The mind has been supposed to lose its power to work as a rubber ball loses its power to bound. As the ball rebounds to a lesser and lesser height, so the mind has been supposed to think with less and less vigor. We have talked as if sleep charged the mind with mental energy as a current might charge a storage-battery with electricity, and that then the mind had this stock to spend. As it spent it, it could exert less and less energy in its thinking. One could easily show the impropriety of such views by demonstrating the inconceivability that the complexity of mental action should fit so simple a scheme, but it is also useful to show the same thing by proof that in the case of certain people the mind does not lose its power to do work from having done large amounts of it. My experiments show in certain individuals no decrease in amount, speed or accuracy of work in the evenings of days of hard mental work over mornings or in periods immediately following prolonged mental work over periods preceding it.

So far as these and many other experiments go, they all agree in denying that the cause for a decreased amount of mental work is such a simple lessening of some one factor, mental energy or whatever one cares to call it. They would affirm, on the contrary, that we did less work when tired, not because this stock of mental energy was running low, but because ideas of stopping, of "taking it easy," of working intermittently came in and were not inhibited; because feelings of boredom led to their consequences of leaning back in one's chair, looking at the clock, etc.; because a certain feeling of physical strain weakened one's impulse

and in some cases four by four. This work, at least for the subjects of these experiments, required the utmost concentration. It is very fatiguing (in the ordinary sense of the word). Any interruption or distracting influence is felt at once and makes successful work impossible. So one would suppose that it ought to show the influence of decreasing power to do mental work as clearly as could anything. The amount of work and the mistakes can be easily and accurately recorded.

Another method involved the addition of columns of twenty numbers, each of five figures. This does not require close concentration, but the work done should show perfectly the fact of mental fatigue in so far as that involves the accuracy and speed of associations between ideas. The speed and accuracy of discrimination of the lengths of lines and of the perception of letters were also used. The tests were arranged so as to eliminate the effects of practice.

EDWARD THORNDIKE.

Western Reserve University.

#### ELEVATORS.\*

By CHARLES R. PRATT, Montclair, N. J., Member of the Society.

THERE is little to interest the engineer in the early history of elevators. Vitruvius describes an elevator built by Archimedes (236 B. C.), operated by manpower applied to a capstan revolving a drum on which the hoisting ropes were wound. Very little advance in the art was made from that time until George H. Fox & Company, of Boston, built a worm-gear elevator in 1850. That this vertical form of railway did not follow the advance of horizontal railways is of course due to lack of demand for that class of transportation during the early application of steam power. Localization of commerce has filled its great centers of distribution with merchants and merchandise to an extent that has added story upon story to our buildings until primitive hoisting apparatus and stairways can no longer accommodate this vertical traffic.

Means for raising freight or passengers have always been adequate to the demands of the times, and the elevator engineer has never hesitated for an instant to furnish greater speed, travel, or lifting capacity when called upon to do so. Mechanical connection with line shafting, direct-connected steam hoisting engines, hydraulic or electric hoisting machines operated by isolated plant or from outside source of power, are all capable of operating elevator cars at any desired speed or load with perfect safety and comfort.

There are, however, so much elaborate and interesting detail in an elevator system, and such a variety of types, as to merit the consideration of this society, especially as there is very little literature, aside, alas! from a voluminous amount of vituperous and unprofitable discussions upon this subject. Let me state at the beginning that no treatise on elevators can be written in the space permitted in a paper before this society; there are too many radically different types to more than briefly sketch the salient features of the most important; and the writer trusts that these will interest the society to the extent of bringing out more complete papers upon individual types.

Let us consider first, briefly, what the requirements of an elevator are, and then describe the different means used to meet them; in order of importance they are:

1. Safety.
2. Reliability.
3. Durability.
4. Economy.
5. Control.
6. Comfort.
7. Speed, load, and travel.
8. Compactness.

#### SAFETY.

Let us classify this by the things which are unsafe for an elevator to do:

1. To fall unretarded to the bottom of the hoistway.
2. To be thrown by its counterbalance up against the top of the hoistway.
3. To be stopped at too great a speed in its descent by a safety catch on the car which will not stop it gradually enough to avoid injury to the passengers, or by a safety catch stopping only one side of a car not built to stand a diagonal strain and thereby collapsing the car.
4. To pay out hoisting rope after the car has been stopped by anything except its own hoisting machine in its descent.
5. To let the hoisting machine continue to hoist after the car has met the top of the hoistway, thereby breaking some connection between the hoisting machine and the car, and depending upon the car safeties to prevent the car from falling to the bottom of the hoistway.
6. To let the hoisting machine run the counterweights into the top of the hoistway and possibly drop them on top of the car.
7. To lose control of the hoisting machine in such a way as to alarm the passengers to the point of jumping on or off a moving car and getting caught between car and hoistway door-sills and lintels.

These are some of the unsafe features of some elevators which have been in general use for the last forty years, and can be taken as the typical conditions for which adequate safety appliances are provided on all first-class elevators. There are two general methods used to prevent a car from falling unretarded to the bottom of the hoistway. One is to stop or retard the car before it attains undue speed, and the other allows it to fall unretarded till it reaches a certain distance from the bottom of the hoistway, where it is brought to a gradual and safe stop. This latter is only used in addition to and never as a substitute for the first method.

A description of all the devices to stop or retard an elevator car by this first method would nearly fill a year's Transactions of this society. I will, therefore, describe only the typical ones in general use.

The most simple device is that operated by the breaking of the hoisting ropes, which, unfortunately

\* Presented at the Washington meeting (May, 1899) of the American Society of Mechanical Engineers, and forming part of volume xx. of the Transactions.



A DIFFICULT FEAT OF HORSEMANSHIP.

demand as much of the horse as of his rider. In every European army, numerous trainers are constantly engaged in teaching horses certain lessons which they must master before they can form part of a cavalry regiment. These four-legged recruits are taught to stand unflinchingly before the flash of a gun, to respond to every movement of the rider's hands or of his knees, to swim across deep streams, to climb and descend steep hillsides.

As an example of the difficult feats performed by European troopers, we have reproduced a picture of an Italian cavalryman of the famous Tor di Quinto school descending a steep hill. The Italian army, it should be remembered, may at some time be called upon to fight in the Alps. For this reason the Italian cavalryman and his horse are taught not only to clamber up hills like an antelope, but also the still more difficult feat of descending them. The feat which we have illustrated is said to be one most commonly performed at Tor di Quinto.

#### MENTAL FATIGUE.\*

THE purpose of this article is to give a preliminary report of some experiments on mental fatigue made by the writer. It is expected that they will later be presented in detail, and accordingly only the method and theoretical conclusions will be now stated.

Mental fatigue may mean either the fact of incompetency to do certain mental work or a feeling of incompetency which parallels the fact or the feeling or feelings denoted by our common expressions "mentally tired," "mentally exhausted." Among the conclusions to which the experiments have led are the following: first, that the fact of incompetency is not what it has been supposed to be; second, that there is no pure feeling of incompetency which parallels it and is its sign, that consequently the mental states ordinarily de-

to read, write or translate; because sleepiness clouded our mental vision; because headaches or eye-aches tended naturally to inhibit the processes which caused them, etc.

As to the pure feeling of incompetency, I fail utterly to find it in myself or to get any intelligible account of it from others. After one separates out from the feelings of mental fatigue the factors just mentioned, especially the feelings of physical pain and strain, the feelings of mental nausea at certain ideas, and the feeling of sleepiness, I do not think that he will find anything left that is worth naming.

That the feelings of fatigue which we do have are not proportionate concomitants with the decreasing ability to do mental work is shown by the fact that all the persons in our experiments reported a large measure of such feelings in cases where their mental work was quite up to the average. In general, a comparison of the introspective records of feelings with the actual mental ability displayed shows that the former are not a parallel or measure of the latter.

The quantitative results obtained would seem to show that the degree of real inability caused by mental work was very much less than has been supposed; that in ordinary life nature warns us by the complex feelings mentioned not to work mentally some time before we are really incapacitated for work. They would also suggest that the results which those investigators who have sought to measure mental fatigue in school children have obtained were due to the use of methods which did not measure the inability, but the distaste for mental work, of the children. One is tempted to put forth the paradox that real mental incompetency is the rarest of all reasons for stopping or decreasing mental effort.

The methods used to estimate the ability to do mental work are to some extent new and so worth mention. The chief was the mental multiplication of three figures by three (e. g., 794×633), of two figures by three,

\* From Science.

for the utility of this device, is the rarest cause of a car falling. When, however, this does occur, and the break must be near enough to the car, if the hoisting machine is located in the lower part of the building, to prevent that part of the rope between the hoisting machine and the overhead sheave from keeping sufficient tension where it is fastened to the car to prevent the device from working, the rope breaking in such a way as to relieve it of all tension at the car, a

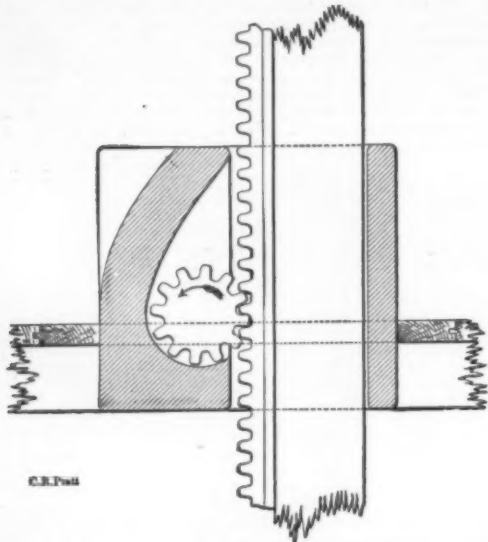


FIG. 1.

safety catch is thrown into action gripping or locking on some support in the hoistway.

This device is sometimes used in addition to more reliable means, but is not considered as at all necessary by the leading elevator companies. Its general design is as follows:

The hoisting ropes are either connected to the car by a system of levers, which are operated by a spring to throw the safety catches when the ropes slack, or they are connected to the car by levers or sheaves,

speed lifting it by pressure of the air and operating the safety catches, or else by a pneumatic piston running like a counterbalance in a closed box, the rope which carries it being connected to the car by a spring balance, causing it to operate the safety catches when the tension on its ropes is increased by increased air resistance due to acceleration. Neither of these pneumatic devices is considered to be reliable.

Hydraulic resistance to prevent an elevator car from falling unretarded to the bottom of the hoistway is applied simply as a hydraulic power pump driven by the car. It is usually located over the hoistway and driven

the counterweight. The drums between the car crossheads are mounted on shafts which revolve in and fastened to the crossheads—a right-hand nut in one crosshead and a left-hand nut in the other; the ends of the crossheads bearing on either side of the shaft. The guide rails act as braking clamps to check the speed in case the ropes break between the car and the hoisting machine, thereby allowing the counterweight to overhaul these ropes, revolve the crosshead drums and screw the crossheads together against the rails.

The limitations of this device are its doubtful gripping powers and the limited functions of its operation

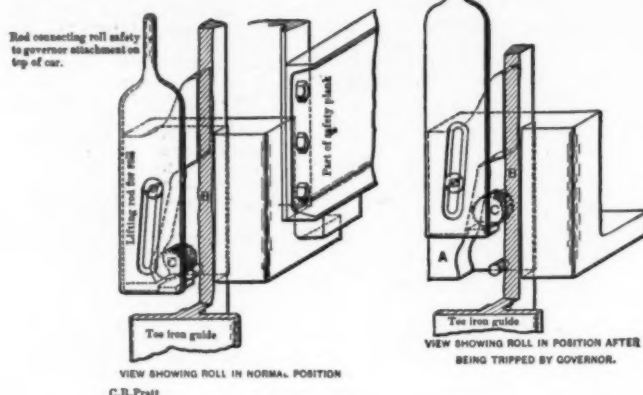


FIG. 2.

by a rope from the car when the car descends, and reversed by the counterweight rope when the car ascends, having its circulating valve wide open during the ascent of the car. This device has all the attributes of perfect safety, but adds materially to the friction losses of the elevator and to the cost of installation and maintenance.

We now come to the most popular device for operating an elevator car safety—a centrifugal governor. This is located either on the car, acting directly on the safety catches, or over the hoistway, where it operates the safety catches on the car by retarding the rope, which is fastened to the car and drives the governor.

Having described all methods in general use for oper-

device; it could not be operated by a centrifugal governor with the rope connections here described.

Wood guide rails form the easiest means of bringing an elevator car to a safe and gradual stop when it is descending too rapidly, and there are many forms of gripping devices for this purpose. The sharp-toothed cam is all right, provided it is not designed to impinge the rail to such a depth as to stop the car too suddenly. Other wood-rail grips either cut deep shavings or crush the rail as they slide. Wood rails, however, are becoming less used every year, as they cost as much as a steel rail when they are constructed and erected in a first-class manner. Their present use is principally for cheaper grades of elevators and dumbwaiters.

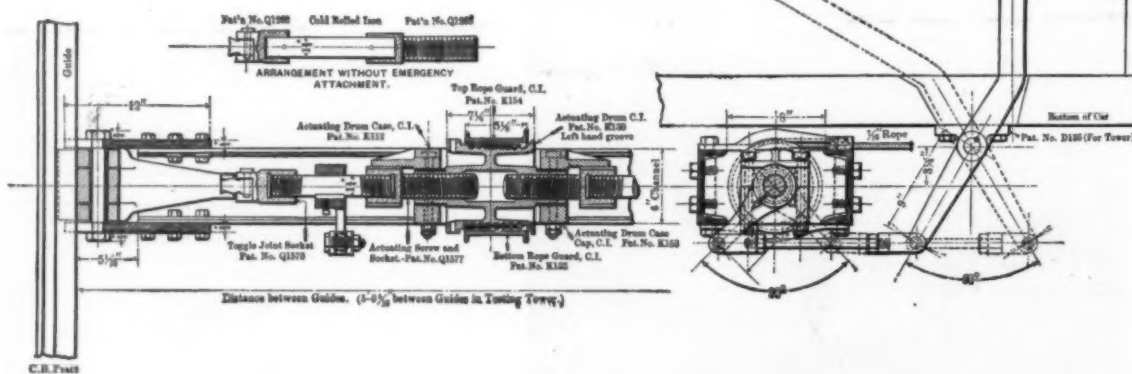


FIG. 3.

which balance the tension of the hoisting ropes against the tension of the counterweight ropes, allowing the counterweight ropes to operate the safety.

This device is a very pretty exhibition safety. All that you have to do is to break the hoisting rope connections at the car, and the car is instantly locked to its safety supports. It can also be operated by grasping the hoisting ropes from a landing door above the car, drawing them toward you, and letting them snap back. This test always satisfies elevator inspectors that the elevator is perfectly safe.

All other means used to prevent an elevator car from falling unretarded to the bottom of the hoistway are operated by acceleration of car speed, which is the only reliable means of operating an elevator safety. Inertia, pneumatic and hydraulic resistance, and centrifugal force are thus used.

Inertia devices have only been tried on very slow-moving cars, one in the form of a sort of floating pinion held in a pocket on the side of the car and meshing in a rack secured to the hoistway, as shown in the sketch (Fig. 1).

As the car descends, the pinion revolves, as shown by the arrow, and under a slow speed remains in its pocket, but any sudden acceleration rolls it up the incline of the pocket and jams it in the rack. Increased friction in the rack may have as much to do as inertia in this operation, but it certainly does its work all right on very slow-speed cars.

Another inertia device consists in heavy pendulums attached to the car and oscillated by waving cams running up each side of the hoistway. The length of the pendulums and the curves of the cams being determined to synchronize with the car speed, no retarding effect is obtained until the speed increases, and then there is trouble. The noise and vibration of a car having nothing but this device to sustain it against the force of gravity can better be imagined than described.

Pneumatic resistance is used to operate an elevator safety catch either by a light wood fanboard suspended below the car on balanced levers and filling the hoistway as much as possible, accelerations of car

ating the safety catches, we will now consider the catches and their merits.

The rack and pawl is only adapted to slow-speed cars and where they are operated by the breaking of the hoisting ropes, as they could never stand the impact of a car falling at any speed above one hundred feet per minute.

Another form of safety catch grips the smooth steel guide rail with as little slip as the rack and pawl, and is equally unfit to be operated by a centrifugal governor or any other device on a high-speed car. It has, however, been used to a great extent under such conditions. Its general design is shown in the sketch

The best steel-rail gripping device has vise-like jaws, that are supposed to slide far enough along the rails to stop the car easily. The first form of this device brought into use, aside from that which screws the crossheads together as before described, had jaws operated by toggle joints, actuated by a right and left-hand threaded screw revolved by a rope controlled by a centrifugal governor, as shown in the drawing (Fig. 3).

This device has been modified to use spring power to operate the jaws instead of operating them by the governor rope direct.

A car safety of this same general character, designed

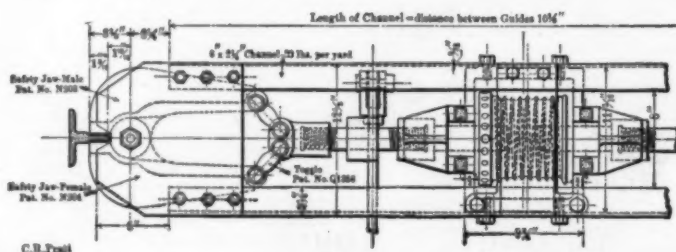


FIG. 3A.

(Fig. 2), where *C* is a sharply corrugated hard-steel roll, and is shown gripping the steel guide rail, *B*, by rolling up the incline of its pocket in the safety block, *A*, which is attached to the car. It nominally rests in the bottom of this pocket clear of the rail, *B*, and is lifted up into contact by a tripping device.

Another form of steel-rail grip is operated by the ropes leading from the hoisting machine, making several turns around drums between the top crossheads of the car, and leading up over sheaves and down again to

by the writer and built in four sizes, varying from 2,500 to 40,000 pounds capacity, has stood some very satisfactory tests. Its construction is as follows:

As shown on the plan, Fig. 5, the car guide rails, *A A*, which are steel tees accurately machined and highly polished by the guide shoes of the car and heavily lubricated, are gripped on either side by the jaws, *B B* and *B' B'*. These jaws are held on the ends of levers, *C C* and *C' C'*, which are pivoted between jaw plates, *D* and *D'*, and guide-shoe stands, *C* and *C'*,



by eccentric pins; the angular adjustment of these eccentric pins, by means of a locking lever, forms a means of taking up the wear of the jaws by setting them nearer the rails.

On the other end of each jaw lever are two rolls, and between the rolls of each pair of levers are wedges,

spring and operating the wedges. The weights, *K K*, pivoted on pins, *L L*, are held against centrifugal force by a torsional spring wound on the governor sleeve and acting on the weights through the collar, *M*, and links, *N N*, which keep the two weights at equal distance from the center of the spindle. Tripping speed

FIG. 6.

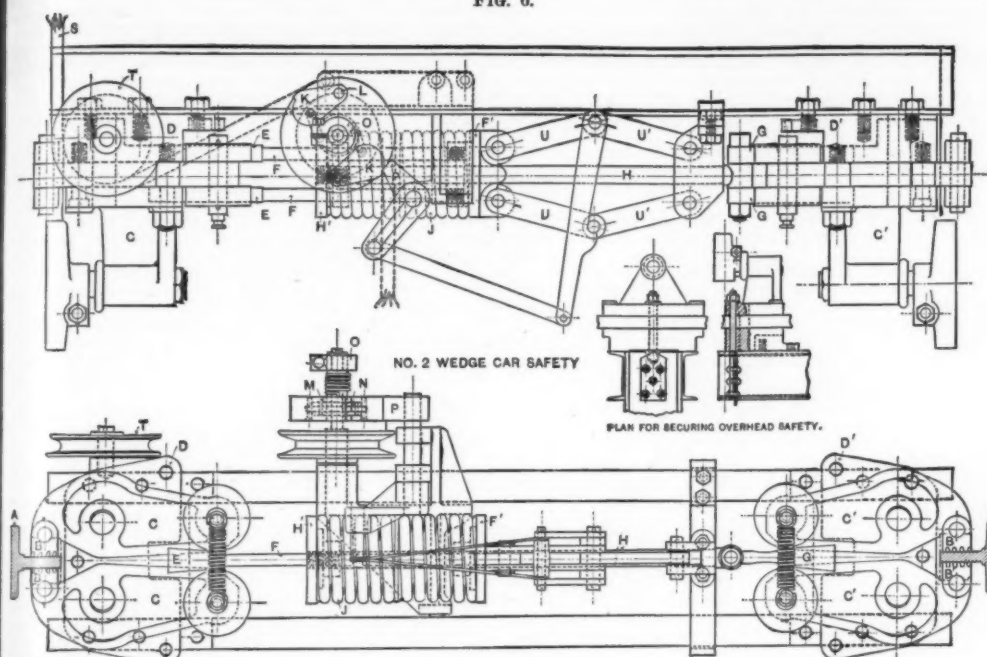


FIG. 5.

which, by forcing the rolls apart, force the jaws on the rails. Wedges, *E E*, are formed on the ends of rods, *F F*, which are tapped into springhead, *F*. Wedges, *G G*, are bolted to eye on the end of rod, *H*, which is tapped into springhead, *H*, thus using the helical spring, *J*, under compression and drawing the two pairs of wedges together by its extension. We have here a device that applies a definite pressure to the rails, is adjusted for any pressure required to stop the car easily and insuring exactly the same pressure on each rail, relieving the car of diagonal strain.

For the benefit of any who may entertain that ancient prejudice against the durability of springs, I will state that these particular springs, after being

adjustment is obtained by regulating the torsional resistance of this spring by turning the split clamping collar, *O*, to which one end of the spring is secured.

In hoisting, the governor weights may hit the trigger, *P*, without tripping it, but as centrifugal force increases their radius of rotation in lowering, until they reach the trigger, the first weight that touches it knocks it off at the first blow. The Pickering governor is very generally used to trip elevator safeties,

The governor shown in Fig. 6 is revolved by the rope, *S*, which is secured to the top of the hoistway and leads to the governor pulley over the idle sheave, *T*, and is kept under proper tension by a weight at the lower end of it.

Means for releasing the safety from inside of the car is obtained by a screw acting on the toggles, *U U* and *U' U'*, by means of the nut, *V*, and links, *W W*. This enables the operator to put his elevator in operation again without delay if the safety was only sprung by undue speed of the hoisting machine, or lower the car to the next landing and let the passengers out if any accident has happened to the hoisting apparatus. So great is the confidence of the men who install these safeties that they have been known to run the car from top to bottom of a high building, regulating its speed entirely by the safety jaws, without a rope on the car.

This, however, is depending too much on the personal element, as the downward plunge of an elevator car, with nothing but free air to check it, is sufficiently trying to some men's nerves to make them forget for a few seconds what to do with that little screw which is holding the safety off. If they let go of it, its pitch is steep enough to spin it out of its nut, but the natural instinct at such times is to hang on to everything rather than let go of anything. The writer does not believe in making it possible to release the safety from the inside of the car, but there are others who insist upon it, and the insurance companies do not object.

We now come to that form of elevator safety that allows the car to fall unretarded till it reaches a certain distance from the bottom of the hoistway, where it is brought to a gradual and safe stop. But this, as before stated, is used only in addition to, and never as a substitute for, any of the safeties already described.

There is but one form of this device worthy of consideration: that is the air cushion formed by the lower part of the hoistway. The value of this device was first discovered by Mr. Albert Betteley, of the firm of Williams, Adams & Company, of Boston, in 1857, when one of his elevators in the State Street block in Boston fell to the bottom, loaded with boxes of sugar, and no injury occurred to the boxes. As the car had fallen from a considerable height with nothing apparent to check its speed, Mr. Betteley was led to look for some unusual cause for this successful fall, and discovered it in the comparatively airtight construction of the bottom of the hoistway.

As a modern installation of this device I cannot do better than to quote from *The Iron Age* of August 4, 1898, and reproduce the illustrations printed in that article:

"The air cushion, located at the bottom of an elevator shaft, possesses peculiar inherent advantages which cannot be gainsaid. First and most essential, it is always ready instantly to perform its work and to do it successfully under all conditions. Of itself it cannot get out of order, since practically it is only a hole into which something may drop sometime. Whether the car dropped one or twenty stories its movement would cease, not suddenly, but gradually and without shock. The first cost of the air cushion is small and the outlay for its maintenance nil. It occupies space not otherwise valuable. All things considered, it is difficult to understand why it is not more widely employed.

"One of the most extensive and elaborate applications of the elevator air cushion is to be found in the Empire building, at Broadway and Rector Street, New York, designed by Kimball & Thompson, Manhattan Life building, New York. The elevators were installed by Otis Brothers & Company, New York, and the air cushions were designed by F. T. Ellithorpe, 136 Liberty Street, New York.

"The building is a twenty-story office building, recently completed and provided with all the most modern appliances and conveniences. There are ten elevators, of the high speed hydraulic type, arranged in two groups of five each, one group being shown in sectional plan, Fig. 8. While nine of the elevators are distinctly for passenger service, one is more powerful and is capable of lifting safes weighing 8,000 pounds. Each shaft is entirely independent from the floor of the third story to the bottom and is inclosed by walls which are not perforated except by the door openings. This forms the air cushion proper, which, as indicated in Fig. 7, is about 50 feet in depth. The doors of the main floor and of the second floor are in two parts which slide in recesses in the wall. They are of bronze and of ample strength to resist the air pressure that would come upon them if a car should fall. The usual open ironwork is entirely absent on these two floors, solid masonry replacing it. The cars have also been strengthened with the view of resisting this pressure. By consulting Fig. 7 it will be noticed that the shaft walls are battered for a short distance below the third story floor. This provides a graduated air escape and adapts the cushion to any fall which the car may make. The car fits more closely in the lower portion of the shaft, the walls of which are vertical. It has been estimated that the air cushion should be in proportion of 1 to 6 of the travel; in the present instance the cushion is 50 feet and the travel 287 feet. In the bottom of each shaft is a suction valve which opens inwardly as the car ascends, thus preventing the vacuum which would result from the car leaving the cushion. There is also an Ellithorpe improved escape valve, which opens outwardly into the atmosphere. It is so adjusted as to sustain the weight of a car under ordinary conditions, but will in case of accident relieve the cushion of undue pressure when the car falls. It has been calculated that the pressure in the air cushion if a car should fall from the top would be 3½ pounds to the square inch. On July 18 a car weighing 2,000 pounds was dropped from the twentieth story. The efficiency of the cushion was shown by the fact that the eggs and incandescent lamps carried upon the floor of the car were uninjured."

Any subsequent fall should be like the first, as there are no joints, packing, or automatic devices to be relied upon to assure the reliability of this device, the air pressure varies with the velocity of the car, and the velocity of the car varies but little with the load. The first or experimental drop in the air cushion will be exactly like every other drop the car may make into it, and nothing but unmitigated vandalism could render it inoperative.

(To be continued.)

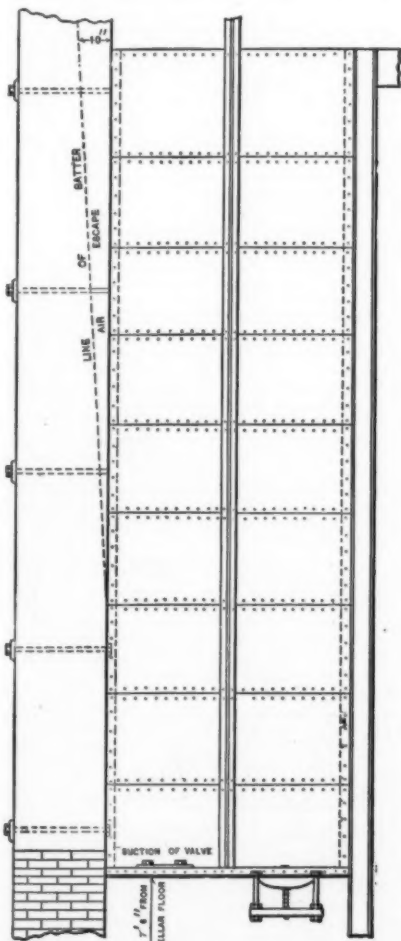


FIG. 7.

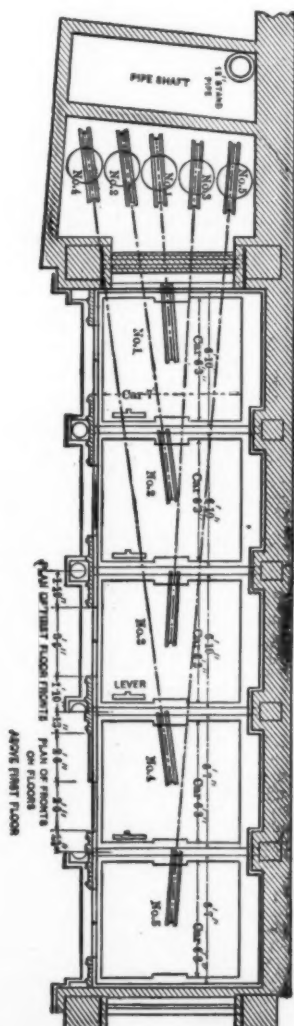


FIG. 8.

held closed for over a year and worked their full working distance over five hundred times, lose three per cent. of their free length and gain from fifteen to twenty per cent. in their resistance of compression.

Fig. 6, the side elevation of this safety, shows the action of the centrifugal governor in releasing the

but the writer's experience with it discovered that it sometimes tripped the safety when the car was being hoisted, and had a way of gently tapping the trigger almost as the car descended, so that it would jar off at some unexpected moment when it was not wanted to do so.



## TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

**Resources and Trade Opportunities of the Amazon Valley.**—Of all the South American republics, I consider Brazil the most important commercially to the United States, says United States Consul K. K. Kennedy, of Para; and in all Brazil the city of Para, by reason of its geographical position and the natural wealth of the surrounding country, seems to me to afford the greatest advantages to our manufacturers and merchants. The merchants here are inclined to do business with the United States in preference to Europe, and we could soon control the field if, as I have frequently pointed out in previous reports, we looked after this trade as Europeans do—sending capable men to canvass the field and study the needs of the people.

It is difficult to obtain official statistics in this country. My previous reports have been based upon personal investigation, and it is pleasing to see that American manufacturers are taking an interest in them, as is shown from the letters of inquiry which I have received from all parts of the United States. Inquiries have even come from England, France, Japan, and China.

The trade of Para and of all Brazil is done on long terms of credit, in many instances as much as six months being given. It is difficult to ascertain with any degree of accuracy a merchant's commercial standing, in the absence of anything like Dun's or Bradstreet's agencies. This is due, in great measure, to insufficient means of communication between the ports and the interior, and the fact that people engaged in the production of natural wealth, which is often not marketable except after delays which cannot be calculated in advance, want easy terms of payment. Another reason for long credits is the strong competition from Brazilian manufacturers in the south. There are few factories in the north; but São Paulo, Rio de Janeiro, and other southern cities of Brazil send shoes, dry goods, hosiery, notions, liquors, patent medicines, and many other goods to this market. It is not difficult to compete with these Brazilian goods, because of their inferior quality, but considering the little or no duties they have to pay and their facilities for giving long credit, they offer a strong competition. Another advantage is that these southern factories provide their agents here with stock to be sold on the spot. I hear that it is much easier to market Brazilian goods which are ready for delivery than the products of other countries.

While the United States is the largest consumer of Brazil's raw material, Brazilian imports of American manufactured goods, even as compared with those from small European countries, are small. Yet the Brazilians, certainly those of the Amazon region, are anxious to trade with us. Goods are coming here from Germany and France, such as bicycles, which are dearer than and much inferior in quality to those made in the United States, but the manufacturers of the former countries have their agents here to show the goods and push their sale.

Openings for new industries in this region are most promising, and the chances are excellent for obtaining State government concessions. Brazilians lack initiative, and almost everything is done with foreign capital. England has not only controlled nearly all the import trade, but is also alive to the opportunities for the employment of capital, and syndicates are being formed almost every week. Now, however, Belgium is sending capital and buying up property in Para, such as the electric light plant. Negotiations are in progress for building the new waterworks, cattle pen, electric railway, and conducting other important enterprises. All awards will be made some time in July, and will go to the lowest bidder. France and Germany have also come into the field, and if American manufacturers expect to keep pace with their competitors, they must be active.

The strong current of immigration which thus far has been supplied principally by Portugal is now coming from Spain and Italy, especially the latter, and it is said that hereafter Portugal will contribute a small proportion as compared with the other two countries. It is claimed, however, that Italy and Spain supply only unskilled labor, a class not desired in the rubber fields. Why this should be so I cannot say; nevertheless, it is said to be a fact.

## THE AMAZON REGION.

I was on the U. S. S. "Wilmington" on her recent trip up the Amazon. The natural wealth of this region is enormous, almost beyond estimation. Overburdened coconut trees increase in quantity as you ascend the river. The thick forests of rich woods, the powerful streams—each one a mighty river—appearing at every turn of the ship, and the endless rows of rubber trees along the banks speak volumes for the commercial and industrial future of Brazil.

I have learned that some accounts which have been written concerning rubber, although not entirely misleading, have not been quite accurate. The impression created by the narratives of previous travelers who have been up the Amazon is that the rubber production is on a constant and endless increase. It is not generally believed, but it is nevertheless a fact, that the output is not likely to increase to any marked degree unless a much larger force of rubber gatherers is sent into the forests than has been employed during the past year or two. This is the opinion of the best informed rubber plantation owners. Reports that the supply of rubber trees is inexhaustible are largely overdrawn. It is true that there is no fear of immediate scarcity of rubber, and perhaps there will not be for the next fifty years. It is believed in well-informed circles that hereafter there will be a gradual but steady shrinkage in the rubber product unless the present force of rubber gatherers is largely increased, because, in the first place, the trees conveniently located near the banks of the rivers are naturally the first to be worked, and in consequence are becoming exhausted from constant tapping, the milk extracted being weaker each year; hence the shrinkage in such rubber is very great. In the second place, the rivers have all been worked inland for a distance of about three miles from their banks, and, in order to reach the so-called unexplored rubber forests still farther inland, it will require much more time and necessitate three times as

strong a force. Owners of rubber farms inform me that milk drawn from rubber trees five years ago possessed twice the strength contained in that extracted from the same tree to-day. The islands near Para are all overworked. Good judges can easily recognize rubber drawn from overworked trees by its peculiar color.

On the banks of the famous Purus River are the most magnificent rubber forests I have ever seen. They form a part of a vast belt which has scarcely been touched. Along the Purus and Jurua Rivers and their affluents grow a greater number of the trees than in all the other regions of the country combined. The extent of these forests is so far beyond estimate that it is impossible to obtain even an approximate idea of the area of this rubber belt.

The Purus River is one of the most important tributaries of the Amazon on its southern side. It rises within the confines of Peru, passes through a small portion of Bolivia, continues in a northeasterly direction through Brazil, and, after draining several plains, joins the Amazon. It is said that its channel is about 2,100 miles in length. The only settlers I saw were located near the mouth of the river.

The River Madeira is the chief tributary of the Amazon on the south. Not many years ago, the outer world was supplied with rubber taken principally from the trees of this region, though it produces the smallest proportion of high-grade rubber. A boom, however, may be started here soon, as I hear that a scheme is on foot to build a railroad around the falls, some distance up stream, thus opening up communication with the upper river. Reports say that the surveys are almost completed, and that several miles of the road are under way. A Belgian syndicate is said to have charge of this enterprise, the same one which is interested in the Para electric light plant, the proposed waterworks, and the harbor improvements here.

The Jurua River, another southern tributary of the Amazon, rises in Peru and crosses a portion of the State of Amazonas. It is said to be about 1,200 miles long, navigable by steamboats for 600 miles. This river is very crooked, and the channel frequently changes. In every direction it is bordered by endless forests. The rubber fields of this district equal those of the Purus. You also see in some places a promising undergrowth of young rubber trees, which is likewise observed on the Madeira.

Great quantities of precious woods are seen everywhere beyond Manaus, and it is said that up the Madeira there are large tracts of mahogany, walnut, cedar, cherry, ebony and many other valuable trees.

The River Negro, which empties into the Amazon at Manaus, is also a large stream. The water discharged from this river is black, hence its name. The channel is very deep opposite Manaus, more than 70 fathoms in many places. Large quantities of Brazilian nuts are raised up this stream and brought down to the market; cocoa trees are also plentiful some distance up the river. Very little rubber, however, is produced here.

The Amazon River above Manaus is called the Solimões as far up as Iquitos, where it assumes the name of Marañon, which it retains to its source. The Madeira and other rivers below Manaus, which city is 1,000 miles up the Amazon from Para, are beginning to be settled; but when the upper Amazon is reached, some distance above Manaus, many miles can be traveled without seeing a single hut. It was quite a treat after many hours of contemplation of those powerful but deserted streams and thick and lonesome woods to suddenly discover a yacht with a few people on board appearing from some of the affluents. One is impressed not only with the magnificent rubber trees of the country, but also with the enormous cocoa fields that are seen far beyond Manaus and the wonderfully thick forests of rich woods. I noted high tracts of land above Manaus, suitable for cattle raising. In view of the extraordinary scarcity of meat at Para and surrounding country, the opening is good. Occasionally I saw a good sized cattle ranch, especially as we drew near Iquitos. I consider the cattle industry in these regions equally as profitable as the quest for rubber, and much more healthful. Horses, sheep, hogs, cattle, and, in fact, every variety of animal was seen on our voyage. I mention this in order that it may be shown beyond doubt that such animals can be raised here; and, more important still, a ready market can be found for all the cattle and sheep that can be brought to this market, and one can get his own price. I cannot say too much upon this subject, as it seems such an exceptionally rare opportunity. I know too well how often Para is entirely out of meat, and also the serious difficulty encountered by those who are attempting to bring cattle here from Buenos Ayres. It is said that out of 500 shipped here a few days since, nearly half were lost; this has occurred not only once, but many times. Texas is nearer than Buenos Ayres, and it should pay to send cattle from Galveston. It seems almost incredible that the scarcity of meat in the markets of Manaus and Para has not attracted the attention of our exporters.

Gold is found at the limit of navigation of the Alto Marañon. The exploration of this region is rather difficult, because the Marañon above Turimaguas is not inhabited except by tribes of savage Indians who are said to endanger the lives of the explorers unless they are armed to the teeth. The climate differs much from that of the lower Amazon and is considered healthy. There are nearly 4,000,000 square miles of rich ground which could be devoted to the cultivation of almost any product, and markets for the large variety of products of this region are not lacking, it being unnecessary to go any further than northern Brazil.

Over 3,000 miles up the Amazon, at the foot of the Andes in Peru, is situated the beautiful city of Iquitos. This is not as large as Para, but its position at the foot of the Andes and the wealth of the surrounding country promise for it a great future. There will soon be many rare opportunities here for the employment of capital, as concessions will be given out for sewerage service, waterworks, slaughter houses, market house, city electric railway, and improvement of the harbor. The Booth Steamship Company, Limited, and the Red Cross Line are already exploring the field. They have recently established a regular line of steamships, sending vessels which are plying between New York and Para up the Amazon to Iquitos.

Our manufacturers, merchants, and capitalists have an immense field in this and the surrounding country,

and, judging from the robust looks of the natives, the climate would seem perfectly healthful. The city is quite elevated. The river at this point is almost if not quite as wide as it appears at its mouth.

As you ascend the stream, the more numerous are the thick, heavy forests and stately trees. The black, matted, and warped undergrowth gives the impression of a most lonesome wilderness.

The sight of these wild woods, I am told, not infrequently produces a terrible effect upon newcomers. Many fortune hunters have visited these regions, settled down, and established themselves; then, later on, attacked by one of those fits of despondency which in seems impossible to overcome, they pull up stakes, abandon all interests and ambitions to become rich, and leave the country.

## NEW ENTERPRISES.

R. Santos, of Santos & Company, New York, has applied to the proper officials of the State of Para for a guaranty of 7 per cent. interest on a capital of £200,000 (\$973,300) to establish a new line of steamers to carry frozen meat from New York to Para. The case will come up for consideration during the coming week.

The governor of the State of Para asks me to inform my government of the fact that the State congress of Para passed a bill a few days since appropriating \$50,000, to which amount the authorities at Rio de Janeiro have signified their intention to add \$200,000, as a subsidy to a reliable company which will establish a new line of steamships to ply between New York, Para, and Rio de Janeiro. The governor manifests deep interest in this new undertaking and expresses the hope that Americans will not overlook this opportunity.

Inquiries are frequently made at the consulate as to the owner of a quantity of railroad ties which are piled upon the river bank here. They are said to belong to an American syndicate which some time ago undertook the building of the railway up the Madeira. Mr. Watrin, of the firm of Watrin & Company, has called to ascertain whether they could be purchased, as he wanted to buy them. Not being able to find the owners, I make mention of the inquiry in this report.

The splendid electric railway established at Manaus, of which Dr. Hebblethwaite is manager and Mr. Charles R. Flint principal stockholder, is now being operated. It is 15 miles in length, thoroughly equipped with all modern improvements, and is certain to prove a paying enterprise.

**Dried Fruit in Germany.**—In reply to inquiries by the Oregon Board of Horticulture (the letter has been forwarded to the board), Vice-Consul-General Hanauer writes from Frankfort, June 5, 1899, in part as follows:

The import duty of 30 marks per 220 pounds on canned fruits or preserves is an obstacle to the sale of United States fruit prepared in this way. Dried and evaporated fruit, however, can be sold at a profit. Up to this time, only dried plums have reached this market from Oregon. Large plums, packed in boxes holding 25 pounds, bring an average price, f. o. b. Portland, of from 4 to 5 cents in United States currency. The boxes should be lined with good paper and be artistically labeled. Apricots, pears, and nectarines should be packed also in boxes containing 25 pounds each. Evaporated apple rings should come in 50 pound boxes. Dried pears and apples are packed in hogheads. Care should be taken that the fruit be dried or steamed on wooden frames, not on zinc, nor should they be bleached by the aid of metallic substances, as the law prohibits these methods.

**Match Monopoly in Colombia.**—The secretary of the legation at Bogotá, Mr. McNally, sends, under date of May 7, 1899, translation of a contract recently published in the *Diario Oficial*. It appears that the French Match Company is recognized as owning the monopoly which was adjudicated to Euripides Salgar in October, 1897. The company renounces its rights to the match monopoly, but this renunciation will not take effect until after the new sale of the monopoly, which is soon to be made, so that the company alone can introduce matches until the new adjudication. The government acknowledges having received from the company the sum of 666,666 francs (\$158,666.54), which is to be left in the hands of the government until the monopoly is granted. The government fixes 640,000 francs (\$123,520) as the basis for the sale of the monopoly, which will be effected within five months. Matches belonging to private parties that have been ordered between January 11 and 24, 1899 (on which dates resolutions were passed, one declaring the importation of matches free and the other suspending the effects of the first resolution), and that have been shipped to Colombia not later than March 28, may be imported on payment of the duties.

**Dominican Duties Payable in Gold.**—The Department has received a report from Consul-General Maxwell, dated Santo Domingo, June 24, 1899, to the effect that the Dominican Congress has passed an act making the import duties payable in United States gold or in the current money of the republic at the rate of \$5 for \$1 gold; formerly the rate was two for one. The act takes effect July 1, 1899.

## INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

- No. 484. July 24.—Reforms in the Cotton Trade—Sugar in Paraguay—Importers in the South African Republic—Siberia No Longer a Penal Colony—Emigration to Siberia.
- No. 485. July 25.—Proposed Railway Construction in Formosa—Inherited Property in France—Bids for Rails in Brazil—Duty on Drug-gets' Scales in Germany and France—Railway Management in Norway.
- No. 486. July 26.—Railway Construction in the Transvaal—Platinum, Iridium, and Osmium in Foreign Countries—Germany's Wool Import—Notes from Dawson City.
- No. 487. July 27.—New Railroad Law of Mexico—Plumbago in Japan and China—German Tool-Machine Trust—Proposed Argentine Tariff—Navigation of the River Volga—Exchange at Guadeloupe.
- No. 488. July 28.—Trade and Industries of Mannheim—Passenger Transit in Shanghai—Machine Trade in Ecuador—Electricity in Ecuador.
- No. 489. July 29.—Judicial Reforms in Argentina—Cotton Spinning Machinery in Japan—Foreign Judgments in Brazil.

The Reports marked with an asterisk (\*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.



TRADE RECEIPTS AND SUGGESTIONS.

**Heat Generation of Incandescent Lamps.**—The heat generation of incandescent electric lamps is frequently underestimated, the opinion being prevalent that these lights are without any danger whatever, since the incandescent body is closed off from the outside world by the glass bulb. Experiments have shown, however, that an ordinary incandescent lamp in a vessel containing  $\frac{1}{2}$  liter of water will heat the latter to  $40^{\circ}$  C. in half an hour and cause it to boil in hardly one hour. An incandescent lamp in contact with celluloid will ignite same after five minutes. Cotton is singed in a few minutes, and soon after set afire. Silk goods are singed at a distance of 10 centimeters in 8 to 10 hours. Consequently the use of the incandescent lamp among decorative fabrics in show windows is not at all without danger.—*Papier Zeitung.*

**Apparatus for Raising Sunken Vessels by Acetylene Gas.**—Such an apparatus has been patented in Germany by Engineer F. G. Nielsen, of Sonderburg. A large iron tank, which is so far filled with water that it has approximately the same specific weight, hence can be easily manipulated in the water, is hooked to the vessel or otherwise fastened to it. For small ships, casks prepared for the purpose are sufficient. In the tank is a tipping drum filled with calcium carbide, which can be tilted by means of a cord leading up. When this is done, the calcium carbide drops into a bag fixed underneath the tilting drum, whereupon the generation of gas takes place. Only 3 liters or 5 kilos of calcium carbide being necessary to generate 1.5 cubic meters of gas, the tank can be filled with gas by the use of a slight amount of calcium carbide, the water present therein being crowded out through bottom holes provided for that purpose. In this manner the necessary number of tanks can be attached to a sunken vessel and given the lifting power under water, so that the ship can be raised.—*Zeitschrift für compressed and flüchtige Gase.*

**Articles of Potato Pulp.**—The subject of this invention and patent of Joh. Knipers, of Lehrs, near Leeuwarden, Holland, is the production of vulcanite-like objects from the residues of the manufacture of potato flour. The process consists in separating the residues by straining, from the peel, etc., and treating the product, after partial dephlegmation, with glycerine and admixture of diluted acid at  $80^{\circ}$  to  $100^{\circ}$  C. A viscid, gummy mass is obtained thereby, which is now dried and pulverized. This powdered, slightly hygroscopic substance is next saturated with 4 to 5 per cent. of water and pressed without increasing the temperature, using moulds if desired. The result is a perfectly homogeneous, solid block of almost metallic ring. By this process an artificial wood material is created, so to speak, since the cell walls are united by the glutin-glycerine-dextrine mixture. The articles thus produced can be worked with cutting and boring tools and the sharpest screw-threads be put on them, so that the material is said to be suitable for all purposes for which heretofore wood, vulcanite, cellulose, or even metal was employed. Besides, this material is said to possess the advantage of being an excellent insulator for electric conduits.—*Neueste Erfindungen und Erfahrungen.*

**International Congress for Applied Mechanics.**—By resolution of March 18 last, the General Commission of the World's Exposition, 1900, has established an International Congress for Applied Mechanics. This Congress will be supplementary to that which was active with so much success in Paris during the Exposition of 1889. By the same resolution, the formation of an organization committee was decided upon. This committee, which is composed of the most famous men of scientific or industrial mechanics, elected M. Haton de la Goupillière president. The Commission has already made the first drafts of a working programme, with the intention of proposing for discussion the most recent questions of vital interest to mechanicians, such as: Mechanical Laboratories, Mechanical Use of Electricity, Quick-running Steam Engines, Mechanics of the Automobiles, of the Tool Machines, etc. The Congress will be opened July 19, 1900, and will last one week, excluding Sunday. The dues have been fixed at 25 francs.

All particulars regarding this Congress for Applied Mechanics are furnished by the secretary of the committee, which is located at the Hotel de la Société d'Encouragement pour l'Industrie nationale, No. 44 rue de Rennes, Paris.—*Technische Berichte.*

**Preparation of Paper for Photographic Postal Cards.**—By means of the following process, photographic copies can be produced, which are especially useful for the manufacture of pictorial postal cards, owing to the simplicity of the process:

Well-sized paper is employed for this purpose. If the sizing should be insufficient, re-sizing can be done with a 10 per cent. gelatine solution, with a 2 per cent. arrow-root paste, or with a 50 per cent. decoction of carrageen. This size is applied on the crude paper with a brush and allowed to dry.

The well-sized or re-sized papers are superior and the picture becomes stronger on them than on insufficiently sized paper.

Coat this paper uniformly with a solution of 10 grammes of ferric oxalate in 100 cubic centimeters of distilled water, using a brush, and allow to dry. Next, apply the solution of 1 gramme of silver nitrate in 100 cubic centimeters of water with a second brush, and dry again.

Coating and drying must be conducted with red lamp-light or in the dark.

The finished paper keeps several days. Copy strongly, so as to obtain a strong picture and develop in the following bath:

Distilled water.....100 c. cm.  
Potassium oxalate (neutral)..... 20 grammes.  
Oxalic acid ..... 0.25 "

After developing the well-washed prints, fix them preferably in the following bath:

Distilled water.....100 c. cm.  
Sodium thiosulphate..... 5 grammes.  
Gold chloride solution (1:100) ... 5 c. cm.

Any other well-working tone-fixing bath may also be employed, however.—*Papier Zeitung.*

SELECTED FORMULÆ.

Spruce Chewing Gum.

Spruce gum ..... 20 parts.  
Chicle..... 20 "  
Sugar, powdered..... 60 "

Melt the gums separately, mix while hot, and immediately add the sugar, a small portion at a time, kneading it thoroughly on a hot slab. When completely incorporated remove to a cold slab, previously dusted with powdered sugar, roll out at once into sheets and cut into sticks. Any desired flavor or color may be added to or incorporated with the sugar.

Tolu Chewing Gum.

Chicle..... 3½ pounds.  
Paraffin wax ..... 1 "  
Tolu balsam..... 2 ounces.  
Peru balsam..... 1 "

Dissolve the gum in as much water as it will take up, melt the paraffin, and mix all together. Now take:

Sugar, finely granulated..... 10 pounds.  
Glucose..... 4 "  
Water..... 3 pints.

Put the sugar and glucose into the water, dissolve and boil them up to "crack" degree (confectioners' term), pour the sirup over the oil slab, and turn into it sufficient of the above gum mixture to make it tough and plastic, adding any one of the following flavors, if desired: Cinnamon, chocolate, sandal wood, myrrh, galangal, ginger, or cardamom.

Cinnamon, chocolate, sandal wood, myrrh, galangal, ginger, or cardamom ..... 4 ounces.  
Tolu balsam ..... 1 "  
White wax..... 1 "  
Benzoin..... 1 "  
Paraffin..... 1 "  
Sugar, powdered..... 1 "

Melt together, mix well, and roll into sticks.—*American Druggist.*

**A Flashlight Apparatus with Smoke Trap.**—M. Rene Michel contributes to The Photo Revue a clever suggestion for trapping the smoke of the magnesium flash, and his idea can be carried out in many ways by the amateur, each adapting the device to his own special requirements. A light box, not too large to be conveniently carried out into the open air, is the first essential, and to the open front of this grooves must be fitted, in which grooves a lid will slide very easily, a large sheet of millboard being convenient as a sliding lid. The box being so placed that the sliding lid can be drawn out upward, a thread is attached to the lower edge of the lid, after which the thread is passed over a pulley fixed inside the box near the top, when the end, is attached to the bottom of the box, so that the thread holds the sliding lid up. The lid will then slide down the grooves quickly, and close the box, if the thread is severed, severance of the thread at the right instant being secured by the very simple expedient of taking care that the lower part passes across the place where the flash is to be produced. So small is the cloud of smoke at the first instant that practically the whole of it can be caught in a drop trap of the above mentioned kind. If the apparatus is not required again for immediate use, the smoke may be allowed to settle down in the box; but in other cases the box may be taken out into the open air, and the smoke buffeted out with a cloth. In the event of several exposures being required in immediate succession, the required number of apparatus might be set up, as each need not cost more than a shilling or so to construct.

Flour Paste.

1. Wheat flour..... 4 ounces.  
Water..... 16 "  
Carbolic acid..... 10 minims.  
Oil of cloves..... 10 "  
Glycerin..... 1 ounce.  
2. Wheat flour..... 4 ounces.  
Nitric acid..... 1 fluid drachm.  
Oil of cloves..... 5 drops.  
Boric acid..... 10 grains.  
Water..... 16 fluid ounces.

Mix the flour thoroughly with the boric acid and water, and strain through a sieve to avoid lumps; add the nitric acid and heat, with constant stirring, until the mixture has thickened. When nearly cold, add the oil of cloves and stir.

3. A "glue paste" for cloth, books, etc., may be made as follows: (a) White glue, 4 ounces; water, 8 fluid ounces; soak for 4 hours, then dissolve in a glue pot. (b) Corn starch, 4 ounces; water, 8 fluid ounces; boiling water, 16 fluid ounces; make the corn starch into a batter with the cold water, and pour into the boiling water. Mix "a" with "b" and gently heat for 10 minutes. If wanted elastic, add 4 fluid ounces of glycerin.—*Pharmaceutical Era.*

**Carbon Prints on Colored Grounds.**—The method suggested by Kruger and Biesalski, and described in Acta, is attracting much attention in Germany, and a long article on the subject is contributed to the Photographische Mittheilungen (June 1 issue, p. 173) by the above mentioned gentlemen. They point out that when the prevailing illumination of a scene is substantially monochromatic, the carbon print on a colored ground will render the subject with truth, a scene in the photographic dark room being mentioned as a theoretical illustration and a very red sunset as a case in point, within the range of ordinary work. In illustration, a scene at the forge printed by collotype on a red ground is issued with the Mittheilungen. The technical details we give in the place mentioned are supplemented by a suggestion that occasionally a glycerin bath must be used to render the gelatin-coated transfer paper less brittle than it would otherwise be. By using a carbon tissue which is not a pure black, such, for example, as the warm black of the Autotype Company, a wide range of delicate combination tints in the fainter gradations can be obtained, and the bearing of this fact on the pictorial aspect is discussed in the paper.

MISCELLANEOUS NOTES.

**The Boston Elevated Railway Company** has recently had a mammoth engine shaft built for its new power house. The shaft weighs  $37\frac{1}{4}$  tons, is 28 feet long, and has a diameter of 38 inches.

**The up-to-date housekeeper** has discovered that aluminum griddle, roll or bread pans can be used without greasing, and that the articles so baked are nicely browned and absolutely clean. This adds another touch of daintiness to such viands and renders them available for the dyspeptic as well as the healthy person. Waffles can also be cooked on aluminum without the use of grease, and as the articles do not stick to the metal, and there is no grease to discolor the pans, they are always bright and clean.

**The foundation-stone** of the extension of South Kensington Museum, henceforward to be known as the Victoria and Albert Museum, was laid by Queen Victoria on May 17. Several members of the royal family, foreign diplomatists and members of both Houses of Parliament were among those attending. The Duke of Devonshire, the Home Secretary, and Mr. Akers-Douglas took a prominent part in the proceedings. The Prince of Wales assisted the Queen in the actual laying of the foundation stone.—*Science.*

**Last year a Japanese "Society for the Study of Savage Tribes"**—Banyokenkyukai—was founded at Tamsui in Formosa. A German translation of a paper by one of the members of this society, Ito Kakyo, appears in the Zeitschrift of the Berlin Geographical Society, and will be read with interest. The author credits these "savages" with having attained some degree of culture, and offers a few sensible remarks on the methods that should be employed to "civilize" them, so that they may survive the process and not die out, as has been the case with the Tasmanians and other tribes.—*The Athenæum.*

**During the season** which closed in May, the total shipments of oysters to the European market aggregated 74,755 barrels, against 64,661 barrels during the season of 1897-98. Shipments by months were as follows: October, 2,806 barrels; November, 6,959 barrels; December, 8,575 barrels; January, 8,454 barrels; February, 6,589 barrels; March, 9,231 barrels; April, 31,047 barrels; and May, 2,488 barrels. The appended table shows the amount of oysters exported since and including the season of 1891-92:

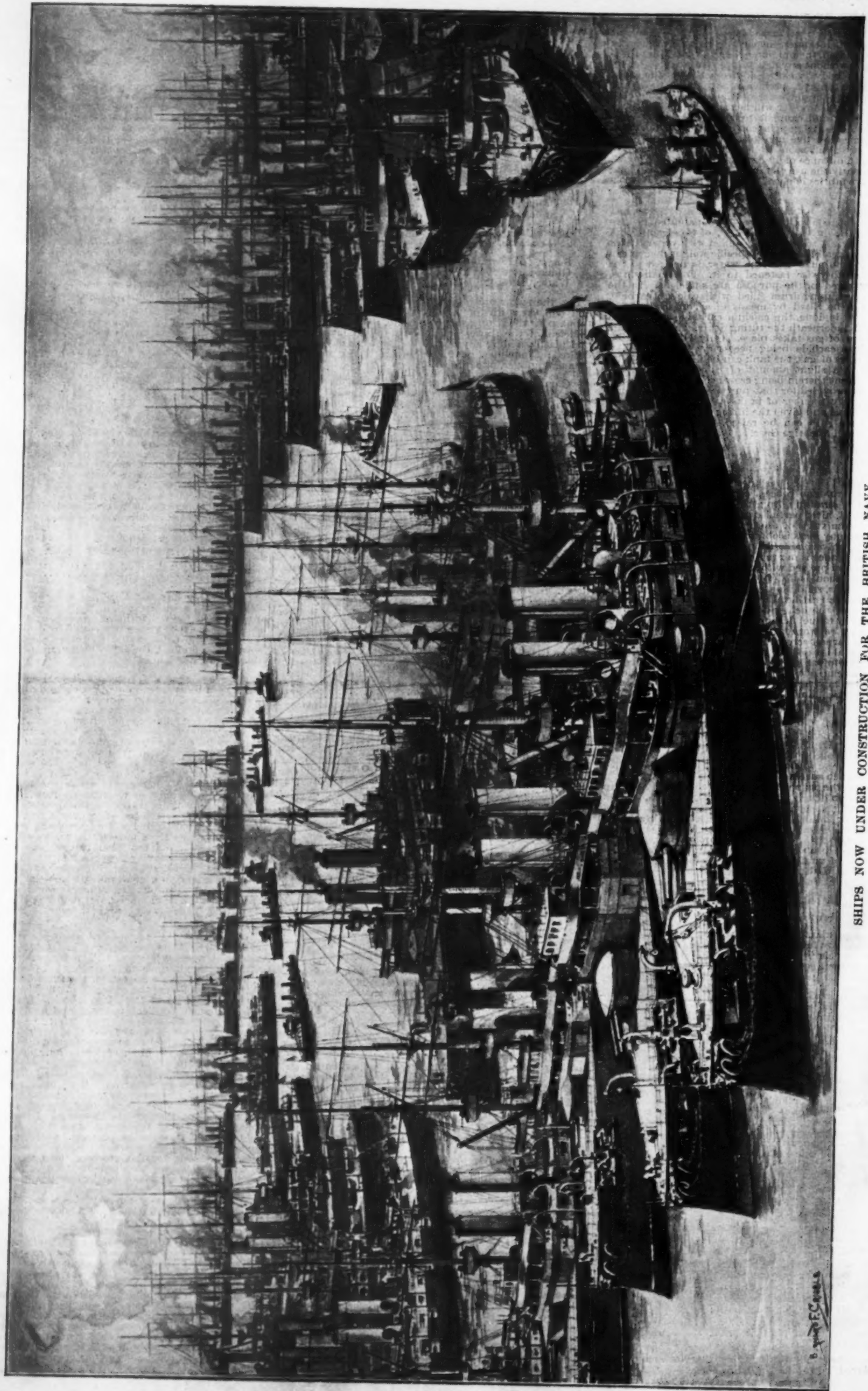
	Barrels.		Barrels.
1891-92.....	109,657	1895-96.....	78,250
1892-93.....	68,966	1896-97.....	70,772
1893-94.....	75,428	1897-98.....	64,661
1894-95.....	70,094		

The heavy shipments last April are accounted for by the fact that in April the bulk of the oysters sent forward are used for replanting European oyster beds. The decline in exports since 1892 is said by dealers here to be due to the agitation on the other side against the American product, the claim being made that the oysters grown here are unhealthy.

**One by one the Alpine passes** have been appropriated by railway lines, and carriages and diligences, and even mules and chaises-a-porteurs, have been supplanted by cars and locomotives on scores of mountain routes. The old diligence route from Geneva to Chamonix, by way of Salanches, has been within a few years invaded by the Paris-Lyon-Mediterranean Railway, which has extended its lines from Geneva to the station of Saint-Gervais, almost under the shadow of the Mont Blanc range; but at this point it has been necessary to take diligences to climb the remaining twelve or thirteen miles to Chamonix. Now, however, the plans are ready for traversing this distance in cars, drawn by an electric locomotive over a narrow-gauge track, and by 1900 trains will undoubtedly enter the village of Chamonix. The River Arve, which drains the glaciers of the Mont Blanc range, will furnish power, two stations having been planned, one at Servoz, not far from Saint-Gervais, and the other at Chavants. Later, it is intended to continue the line through the Chamonix valley through Argentiere, toward Martigny, stopping at the Swiss frontier, but definite plans have not yet been made for this part of the work.—*American Architect.*

**The principal subjects** reported upon at the annual meeting of the American Railway Master Mechanics' Association were as follows: 1. The importance of a test department, a research laboratory in railway service, and a proposition to establish such a laboratory under the direction of the association. 2. The relative merits of cast iron and steel-tired wheels. The former are now of such excellent material and manufacture, and are so reliable and durable—owing to the highest test requirements—that the use of steel-tired wheels seems likely to be limited to cases where a diameter of over 36 inches is required, or where long and heavy application of the brakes in mountain service is likely to overheat the wheels. 3. The ten-mile basis for engine statistics is more accurate than the old engine-mile basis, but requires more careful accounting and more intelligent use. Its accuracy depends in large measure on the accuracy of the record of the actual tonnage hauled, and the actual amount of coal delivered to and used on the locomotives. 4. The purification of water for boiler supply; including the use of different methods for different qualities of water, and the comparative cost and economy of treatment. 5. Stay bolts are being made and fitted much more carefully since the introduction of high steam pressures. Hollow or drilled bolts are the safest, and they are usually turned down to taper with a minimum diameter at the middle. 6. The use of blind or flangeless tires on mains having three and four pairs of driving wheels is decreasing, and this decrease is mostly on roads having many and sharp curves. Some years ago, one railway used blind tires on the leading drivers of four-coupled bogie engines, but the present tendency is to have flanged tires on all wheels. 7. The best method of preventing the cracking of friction plates is not so much in variation of shape as in the purification of water supply. Corrugated or cupped sheets, or special forms of fire-box, may prevent cracking in certain localities, or under certain conditions, but as a rule greater results may be obtained by improving the water, so as to check scaling and peeling of plates and stay-bolts.





SHIPS NOW UNDER CONSTRUCTION FOR THE BRITISH NAVY.

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SHIPS BUILDING FOR THE BRITISH NAVY.

OUR illustration of "Ships for the British Navy" gives a good idea, says Black and White, of the enormous total of vessels now projected, constructing, completing, or under trial for the fleet. Owing in part to the strike in the engineering trade, which has retarded the completion of very many vessels, in part to the extraordinary efforts of the past few years, we have today what is in itself a veritable navy in hand. Taking only the largest class of battleships and cruisers, thirty-five of 9,800 tons and over are in a more or less advanced stage of construction, or almost exactly as many ships of the class as the whole French navy, completed and completing, possesses. The full details of our ships building are as follows:

Battleships of the First Class.	Armored Cruisers.	Protected Cruisers.
12,950 tons Canopus Goliath Ocean Albion Glory Vengeance	14,100 tons 23 knots King Alfred Africa Drake Leviathan	11,000 tons 30½ knots Amphitrite Ariadne Spartiate
15,000 tons London Venerable Bulwark Implacable Irresistible Formidable	12,000 tons 21 knots Cressay Aboukir Hogue Sudley Euryalus Bacchante	5,600 tons 21 knots Hermes Highflyer Hyacinth A B C
14,000 tons Cornwallis Duncan Exmouth Russell A B 18	9,800 tons 22 knots Essex Bedford Kent Monmouth	2,135 tons 30 knots Pandora Pioneer Prometheus Pyramus Perseus

Besides these ships, which displace between them over 488,000 tons, or as much as the total displacement of the whole United States navy, eight sloops, four light draught gunboats building for the Yangtse, and about thirty destroyers, besides two first-class torpedo boats, must be included. This gives a total of some ninety vessels in the category of ships not yet completed for the navy.

Excepting one or two of the destroyers which have been singularly and most unaccountably delayed, all these ships were laid down in 1896 or the following years. The general impression that it takes only two years on an average to build a battleship in England is not confirmed by an examination of the list of ships building. The first five of the "Canopus" class appeared in the 1896 estimate, and were laid down in the closing months of 1896 or the opening months of 1897. Not one of them is as yet complete, though the "Canopus" should be ready for sea this autumn. They have all been thirty or thirty-one months in hand.

Again, the intended construction of the "Formidable," "Implacable," and "Irresistible" was announced in March, 1897, but they were not placed upon the stocks till just a year later, in March or April, 1898. If, as should always be the case, we reckoned the time taken to construct a ship from her first appearance in the estimates to the completion of her trials, three to three and a half years would be the average for our larger vessels. Yet even this figure, though at first sight not very wonderful, compares favorably with the results obtained in foreign navies. Russia, however, has lately taken to buying ships in the United States, and a large cruiser ordered last year for her will be delivered this year, while a battleship, also ordered last year, will be ready next spring.

One fact which appears both from our illustration and from the table given above is the large number of ships of each type that we build. In battleships, for instance, we have three groups, each of six ships all identical. The groups are further very similar in offensive and defensive power and steaming radius to each other, so that they are well adapted to act in unison. All have water tube boilers, which, in spite of the furious and prejudiced attacks now being made upon them, have been adopted by every navy in the world. The fastest group of the three is the "Cornwallis" type, the ships of which will steam 19 knots with natural draught; the "Canopus" class is expected to do 18½ to 19½ knots, and the "Formidable" class 18. All are almost identical in armament; each carries four wire 12-inch guns and twelve 6-inch quick-firers, besides a small number of 12-pounders and 3 pounders. In this latter direction they are far more weakly gunned than the new Russian ships, which carry forty-six small guns against our "Cornwallis's" eighteen.

In outward appearance, it would take a trained eye to distinguish between the various types. They appear very much the same with two funnels, two military masts, and the high freeboard which is now inseparable from our ships. Great seaworthiness and extreme endurance are aimed at by Sir William White in his designs, and generally obtained. As for the steaming power of his ships, we may note that the "Renown," with one screw damaged, crossed the Atlantic at a uniform pace of a little over 15 knots, or about 4 knots more than the "Oregon" made on her record voyage. The "Cornwallis" class, with full load, should be good at sea for 17½ or 18 knots.

Next in importance to the heavy battleships come the armored cruisers, of which so many are building for the navy. These are virtually battleships, in which protection and armament are somewhat reduced to get a higher speed. Far the finest are the four improved "Powerfuls," known as the "Drake" class. The "Powerful" had no plating on her side; these ships have 6 inches of Krupp steel. The "Powerful" only carried two 9.2-inch and twelve 6-inch guns; these have two 9.2 and sixteen 6-inch guns. Lastly, the "Powerful" steamed only 21.8 knots; these are to steam 23. They will be huge four-funnelled vessels, in general outward appearance differing little from the "Powerful." Like her, they will be at home in any sea, and able to face the worst weather. In fighting qualities, they are fully equal to most British and foreign battleships of not the most recent construction.

They are followed by a class of six armored cruisers, smaller, slower, not so heavily armed, but all the same of 12,000 tons, known as the "Cressays." These are to be seen in the foreground on the right. They are to steam 21 knots, and carry the same battery as the "Drakes," except that they have four less 6-inch guns.

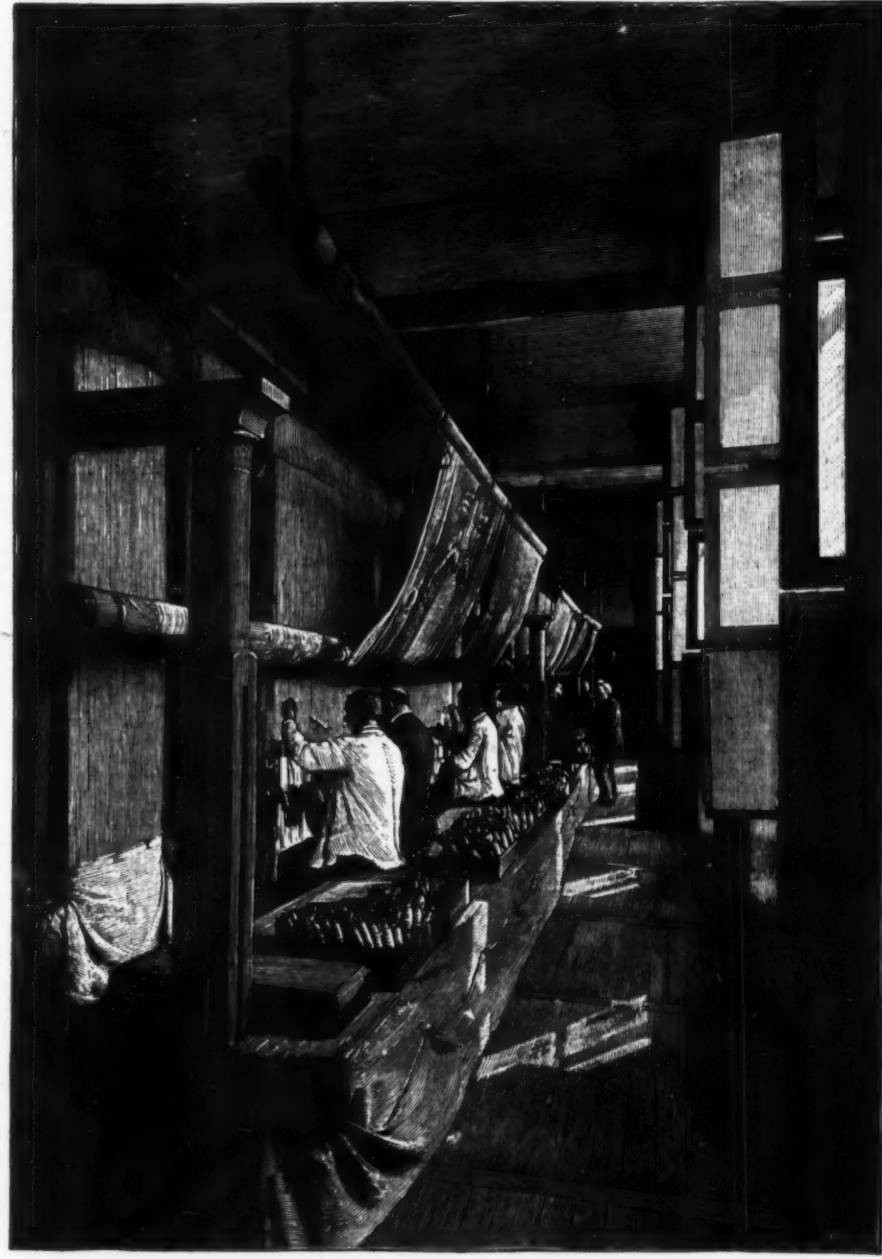
They also are, and are designed to be, something very near a battleship. Admiral Sampson of the United States navy is inclined to think that this class of powerful armored cruiser will gradually displace the slower and heavier battleship. If so, it is thoroughly satisfactory to reflect that we have so many of the kind in hand.

The smallest of our armored cruisers, the "Essex" class, are not the least interesting; they will, probably, have three funnels, differing in this respect from the preceding, which have four. They are to steam 23 knots, and will carry fourteen 6-inch guns, all behind 4-inch armor, while armor of the same thickness will protect their waterline. They are splendid designs, combining all the ideal features of the cruiser, and should be much superior to the American armored cruisers "Brooklyn" and "New York," which did such good service in the late war.

The first six in the list of protected cruisers have been often described. The "Amphitrite" and her two sisters are reduced copies of the "Powerful," and are defective from their want of side armor. The "Hermes" is a good specimen of the moderate sized heavily armed cruiser. As for the new ships, A, B, C, they are to be of different type, and should steam 25 or 26 knots to

THE MANUFACTURE OF GOBELIN CARPETS.

THE Bièvre is a little stream which runs through the southern part of Paris and empties into the Seine near the Orleans Station. It behaved so badly in the matter of inundations that finally it was put underground. Between the Bièvre and the Rue Mouffetard are the buildings of the Gobelin manufactory. The superiority of the products of this factory is by some attributed to the peculiar saline properties of the stream which have been noted by Rabelais. It was doubtless in consequence of the tinctorial qualities of the river that the brothers Gobelin established on its banks their famous manufactory. It is to these brothers that the name of the establishment is due. They were famous dyers that came to Paris in the middle of the fifteenth century and began their work on the banks of the Bièvre, under the reign of Louis XIV. The Gobelins at this time was really a kind of school of furniture in which not only tapestry, but cabinet work of every kind was cultivated. Here 250 weavers produced the richest tapestries after the works of the best painters. The Court and Paris society began to have a passion for ornamentation, and the result was that the manu-



THE CARPET WORKERS-MANUFACTORY OF THE GOBELINS.

meet the Russian cruisers of the "Novik" class, two or three of which are to be ready in 1900, and which are to steam 25 knots. In 1890, 19 or 20 knots was considered a fair speed for a small cruiser, but lately sharp competition between the powers has sent up speeds very much, while the water tube boiler gives the designer plenty of power on a low weight. The small cruisers of the P class are not very interesting; several are already in service, two with the Channel Squadron. They are seaworthy, but not very fast, and are rather lightly armed. The sloops are rigged to use sail power as well as steam, and are useful little ships for colonial service. They draw very little water and are meant for police purposes rather than for fighting. Ships of this class in the United States navy, however, did good work on the Cuban coast in the late war.

Of the light draught gunboats, one, the "Dwarf," had her trials some weeks ago. She made 13 knots. What promises to be the fastest vessel in the world is building for the navy in the turbine-engined "Viper." She is expected to go 35 or 36 knots, and her small 312-ton hull will hold machinery developing 10,000 horse power. Yet she is only the first experiment in a new development which may give us yet greater wonders.

facturers never lacked orders. Lebrun painted for the Gobelins in order that his pictures might be reproduced in wool, and many quite celebrated painters were attached permanently to the staff of the establishment. Lebrun was succeeded by Mignard as director, and an architect named La Chapelle-Bessé was appointed architect and builder, and under their joint direction a school of drawing was created at the Gobelins. The manufacturers sustained great losses owing to the reverses of Louis XIV. during the last year of his reign. It was found it was no longer possible to pay the wages of the best workmen, and from this time on the establishment has concerned itself only with the production of tapestries, and allied to it is the carpet manufactory of the Savonnerie, an old factory of the state which formerly had a separate existence. The products of the Gobelin establishment are not offered for sale by the state, but are used for the decoration of palaces and public buildings and as presents to foreign nations. Occasionally, however, the Gobelins have executed orders for men of wealth and high position. The revolution was not favorable to the Gobelin manufactory; still, however, it was not interfered with, but the government subvention ceased to be paid. During the empire the Gobelins were regarded as a state institu-



tion, and it also enjoyed the full patronage of the Bourbons at the restoration. The government of Louis Philippe ordered a large number of tapestries for the royal palaces of France. The different revolutions which have taken place in France have never really affected the position of the Gobelins. It was in the laboratory of the Gobelins that Chevreul, the great French chemist, studied and experimented for sixty years, during which time he not only carried on the practical working of the manufacturing establishment, but also made public researches on light, colors, and dyes. All dyeing is done in the old fashioned manner with mordants, and the greatest possible care is used in mixing, the temperature, etc., and the results obtained are recorded in the great journal of the laboratory and specimens of the result are affixed to the record. No less than 14,000 different shades are dyed in the establishment. The beauty of the system is that any desired standard shade can be produced or reproduced at will, so that a painting may be copied with great realism.

The weaving of the carpets is done by hand, and our engraving shows one of the workshops where it is accomplished. Each piece of coloring yarn was tied to the warp or chain, the latter running vertically between the upper and the lower beams or rollers, which correspond to the warping beam and the cloth beam respectively in the ordinary loom. A piece of yarn two inches in length is passed back of a warp thread and with a deft movement securely tied, leaving two projecting ends on the face side. The pattern is outlined the exact size with colored chalk on the stretched warp threads; and the model, colored exactly as the carpet is to be, is attached over the workmen's heads, for several men work at once on a carpet, each doing a vertical strip. The knotted tufts are snugly beaten down as the wool threads or filling threads are, so that the fabric is firm. The necessary knotting threads or tufting threads are chosen and laid out before beginning the work. If there are 150 shades employed in the original design, there must be 150 in the carpet; and if the shading in the original design has been done with a brush and blended, there will be needed hundreds and possibly thousands of different colored threads. For example, if there is a green scroll or leaf which presents a round appearance and has considerable area, then each tuft of wool must be so shaded darker or lighter than its neighbor that there may be no break or jump of color such as are observable in ordinary worsted embroidery. The workman is the only judge as to the selection of yarns to match colors in the design pattern. Such is their skill that four or six workmen side by side, each producing the same details of a pattern, leave no observable difference and no perceptible breaks between their respective portions. When the entire strip is tufted, the tufts are shorn to even length so as to present a smooth, thick, soft pile which has the merit, aside from the decorative features, that it cannot be dislodged by wear; and so intimately are the threads and yarn of the fabric interconnected and bound together, that even a perforation does not "spread" as in ordinary fabrics.

The day's work of an operative in the carpet department at the Gobelins seldom exceeds a strip a foot long and an inch wide and is often very much less. The manufacture of the tapestries at the Gobelins is described in our SUPPLEMENT, No. 1050. For our engraving we are indebted to "Encyclopédie du Siècle, l'Exposition de Paris 1900."

#### SMOKE CONSUMPTION AND ECONOMY OF FUEL.

INDUSTRIAL economists in Germany are just now greatly interested in the development of an invention which promises to solve more effectively than has been done hitherto the problem of consuming bituminous coal, slack, sawdust and other inferior forms of fuel without smoke and under conditions of extreme economy. This is the process of Mr. Paul Cornelius for the consumption of low grade fuels, patent No. 100,437 in Germany and No. 613,359 in the United States, although the practical process has been greatly modified and improved since the original patents were issued.

The process consists simply in distributing heated and slightly compressed air through hollow grate bars to the whole lower surface of the furnace, which, being injected upward through the mass of burning fuel, secures equal and perfect combustion and an intense, regular heat from materials that would not be available if burned by ordinary methods. This system has been in practical use since September last at the works of Messrs. Reissner, Wahl & Company, manufacturers of cloth at Guben, in this district, and since December last at a large hotel in Berlin, where a steam engine supplied by two boilers is kept in service to drive a dynamo that generates electric current for lighting purposes, elevator, etc.

In view of the extraordinary interest which attaches to this subject and its prospective importance in abating the smoke nuisance in cities and bringing into use vast quantities of material which are now practically worthless, I have visited the installation in Berlin, and this is what was there exhibited:

The two boilers are of the ordinary flue pattern, placed side by side, and their furnaces separated by a dividing wall, so that one can be thrown out of use or turned on, as occasion may require. The furnaces are about 10 by 4 feet in area, and the smoke passes by subterranean flues to a stack chimney standing in a central court and rising above the roof of the building. Near the furnaces is located an ordinary fan blower, driven by an electrical motor of one-half horse power, the speed of which is easily controlled and which drives the air through a 6-inch pipe into a hollow iron chamber about 10 inches deep, which forms the front section of the hearth of the furnaces. Into this air chamber is fitted one end of the hollow grate bars, which are about 2½ inches in diameter, extend backward the length of the furnace, and are supported by ordinary bearings at the farther end. These hollow grate bars are round on the bottom, but at the top are hexagonal, presenting three faces, each pierced with holes about two inches apart and beginning with a caliber of one-eighth inch, which increases slightly throughout the length of the bar, to equalize the discharge of air from the gradually decreasing pressure within. The hollow grate bars are laid about 6 inches apart, and there is placed between each pair three solid triangular

bars, which assist in sustaining the weight of the burning fuel. The air being forced by the fan blower into the hollow chamber, is there heated from the fire on its upper surface, then passes into the hollow grate bars and is injected upward in three rows of jets, one vertical and two inclined to right and left, so that the entire under-surface of the burning mass resting on the grate is fed constantly by jets of fresh-heated air, which generate from the most ordinary grades of fuel an intense white heat, which can be perfectly controlled by regulating the speed of the fan blower, and produce a combustion so natural and perfect that the smoke is entirely consumed.

At the time of my visit, the fuel in use was what is known as "Coakgräse," or coke dust, the fine slack that comes from screening gas coke, the scrapings of retorts, etc., which has hitherto been regarded as worthless, except for ballasting roads and footpaths. The bed of burning fuel was maintained over the surface of the grate about 5 inches deep, and the fire was white, intense, and evenly distributed. The air current being stopped, the fire at once dropped to a reddish tinge and began to smoke.

Mr. Cornelius' original invention contemplated reinforcing the combustion by impregnating the injected air with a small proportion of cheap oil gas; but experience soon taught that pure heated air was quite sufficient, and, further, that the air chamber, instead of being located at the front end of the furnace, should be at the rear or farther end from the door, where the heat is most intense and whence the current in the grate bars is injected forward—that is, in a direction opposite to the draft of the furnace itself. The hollow grate bars are of cast iron, made in sections about 3 feet in length, with pierced flanges which enable them to be bolted together at the ends, so that the bar may be lengthened to fit any furnace. Being protected by the current of air, the bars are practically indestructible by fire; those in use since September being still in good condition.

With an apparatus so simple and natural in principle as this, some surprising results have been already obtained, although the practical application of the process is in its infancy. The proprietor of the hotel, who has had the apparatus in use since December, gives it the highest approval, stating deliberately in his certificate that it has reduced by three-fourths his outlay for fuel, worked with efficiency at all times, and completely eliminated the smoke and soot which formerly, when the best Silesian lump coal was used, blackened the walls and floor of the hotel court and formed a nuisance of which his guests complained. It was in fact for the purpose of abating the smoke and soot plague, rather than of saving expense of fuel, that the system was adopted for trial. The coke dust used as fuel contains a high percentage of inorganic matter, and the yield of ashes is thereby necessarily increased; but, all elements duly considered—cost of fuel, labor of removing ashes, etc.—the fuel cost of running the engine, month by month, as compared with the previous year, has been less than one fourth of the fuel cost for the same boiler, engine, and electric current, generated with Silesian lump coal.

At the cloth works in Guben, the problem was somewhat different:

1. To get rid of the smoke and soot which poured from the furnace chimney and defiled the premises; and
2. To use as fuel a kind of brown coal found in large abundance near the factory, which contains about 2,400 calories, and is therefore a fuel of too low a grade to be used by ordinary means.

For this reason, the market price of this brown coal delivered at the factory was only 6 cents per centner, or \$1.20 per metric ton (2,200 pounds)—a very cheap fuel indeed, for Germany—but with the Cornelius grate bars it was so absolutely smokeless and otherwise so satisfactory that, after three weeks' experience with one boiler, the managers had their three boiler furnaces converted to the new system, and after eight months' constant use certify that:

1. Their saving in fuel by the use of brown coal, instead of Silesian steam coal, has been 110 marks (\$26.18) per week.
2. The smoke and soot from which they previously suffered have been entirely suppressed.
3. The grate bars remain in as good condition as when first used, and the fire burns easily and under perfect control, so that no injury has resulted to boilers or furnace walls.

Exhaustive tests of the new system have been made by Mr. Gustav Dürr, directing engineer of a large tubular boiler factory at Düsseldorf, who writes in most convincing terms, declaring that the Cornelius system of furnace construction will bring into use as fuel for steam and many other heating purposes, not only the vast product of coal dust from the Westphalian coal and iron district, which has hitherto been used for road making and ballast for railroad tracks, but also the immense brown coal and peat deposits of Germany. This, in many manufacturing districts in this country, will revolutionize the whole economy of heating for steam and other purposes, and German economists are already counting upon the sudden advantage that this new method will give to certain of their industries, which now have to use expensive coal brought from long distances.

Another series of tests, extending over a period of six weeks, has just been made in Berlin, by M. Ternberg, chief engineer of the government of Sweden, as a result of which negotiations are now in progress for the sale of the Cornelius Swedish patents to the government of that country, in order to enable the people to utilize the vast deposits of peat, which cover thousands of square miles in Scandinavia, where little or no coal exists, and almost the entire supply has to be imported from Great Britain.

From the standpoint of general utility, the advantages which seem to have been secured by this system, and which will render it important to the United States, may be summarized as follows:

1. The smokeless consumption of bituminous slack and other waste of mines and coke works in cities and towns.
2. The use for steam and heating purposes of the lowest grades of Western bituminous coals, peat, sawdust, etc., and the vast mounds of anthracite waste that now encumber the mining districts of Pennsylvania.
3. In naval vessels, notably torpedo boats, to secure

such complete consumption of bituminous fuel as to eliminate smoke, which serves to indicate the presence and location of a war vessel to an enemy.

It will be understood that while any fuel—lump or nut coal, for instance—burns fiercely on a Cornelius grate, perfect combustion with consumption of smoke gases requires the fuel to be pulverized, so that for naval purposes, lump coal would have to be crushed in order to secure the best results.

FRANK H. MASON, Consul-General.

Berlin, April 25, 1899.

#### IMPORTANCE OF FILLETS AND ROUND CORNERS OF MODERN MACHINERY CASTINGS.\*

By JOHN M. RICHARDSON.

TAKE some machine tool casting, a lathe or planer, for instance, made from twenty-five to forty years ago, and compare it with one of the same class brought out at the present time by any up-to-date concern, and what is the first point of contrast noted? You will all answer, "the design." Wherein is this difference of design? It is to a great extent in the large and smoothly rounded curves and heavy fillets everywhere present in its outline. Broadly speaking, some of these old style castings look as though a carpenter had nailed together some sort of a foundation, and then, visiting a planing mill, had procured a quantity of mouldings, and with them trimmed it very liberally wherever possible, and finally, by some flourish of the magician's wand, this would-be pattern had been suddenly transformed into iron and set down in the machine shop adorned with bright red and green paint, or a combination of both, neither "a thing of beauty" nor "a joy for ever."

Sharp angles, fancy mouldings, panels, etc., look very nicely on doors, store counters, and a great many kinds of furniture, but are decidedly out of place and likewise impracticable for cast iron. I consider it of great importance to have a machine casting designed so that its exterior will present as smooth a surface as possible, and all angles and recesses of any kind provided with good liberal fillets. The advantage of this does not lie along any one line, but every one of the four mechanical arts, namely, draughting, pattern making, moulding, and machine work, which are so closely joined and interlocked as to be but four links of a giant chain, of untold strength and value to mankind, are each and every one benefited thereby. A drawing where this matter has received attention presents a much more finished appearance, and reflects credit on the designer, for it shows that he looked ahead as far as the foundry, realizing that the design and its resultant casting bear a close relationship to one another. Many a condemned casting is such, not through any fault of the moulder, but rather from bad proportioning of the metal, sharp angles, no fillets, etc., directly traceable to the draughting room.

In the pattern department fillets serve a very important purpose; and now I am treading on familiar ground, and therefore can without hesitation give a short outline of their merits and demerits. A fillet is actually a pattern strengthener, aside from its foundry value, provided it is composed of a substance having some tenacity in itself, and aside from this property it is very often a time saver also, for in fitting hubs, bosses, and ribs over curved surfaces, or, in fact, any part fitting another, where the intersection does not lie in a plane, much time and labor is required to produce a close fit, but a firm bearing can be quite easily arrived at, having perhaps rather open joints here and there, and here the fillet aids the pattern maker by effectually hiding the imperfection. The moulder who keeps his eyes open will notice quite a variety of materials worked into fillets on the various patterns he handles, especially if he works in a jobbing foundry. Wood, leather, lead, beeswax, and putty comprise the kinds ordinarily used, and they each have their time and place, except the metallic one. A pattern being of wood has a fibrous nature, which will hold glue or any other adhesive substance, while lead has no affinity whatever for glue; so the only thing that can be employed is shellac or nails. I have used yards and yards of lead fillets, so can speak from experience, and I have seen old engine beds and their foundation boxes returned for repairs where these fillets were fairly stripped away from the pattern; even the small bunghead wire nails used would not keep them anchored down. Probably the finest fillet of all is made of wood, worked out of the solid pattern, having no feather edges whatever, but this is a very expensive kind, and can only be used on the finest jobs, so in everyday practice we have to add the fillet to the pattern as a separate part. For fillets from 1 inch radius down to ¼ inch, leather is unquestionably the best and most practical material that can be used, and when properly applied will not peel up even with the hardest usage, and requires no nailing whatever, glue being the only agent employed. Those who condemn the leather fillet for patterns probably do not understand the proper method of applying it. There is a sort of trick about it, to be sure, the keynote of success being hot water. Cover the back of the fillet with thick glue, and place it quickly on the pattern, instantly drawing a round-ended slicking tool of proper radius along its surface, bearing down hard to exclude any superfluous glue, and following this with a woolen cloth wet in very hot water, to remove all pressed out by the slicker. Repeat this until not a particle of glue squeezes by the edge of the fillet, then wipe with a dry cloth.

This is really not so much of an operation as it may seem from the description, and many feet of these fillets can be applied in a very short space of time. Where it is hard to bind the leather neatly around small curves, etc., just immerse it in hot water, taking it out instantly. This renders it perfectly pliable, but it means quick work, for the thin edges will shrivel and harden at once if not immediately placed in position and burnished down as previously described. A leather fillet put on properly, with strong glue, can only be removed when dry by main force, and will then come off with fibers of the wood adhering to it, and sometimes the leather itself will keep breaking; it takes so much force to make it let go. Light patterns are strengthened by them to such an extent that nails

\*Presented at the Pittsburg meeting, May 17, 1899, of the American Foundrymen's Association.



are frequently unnecessary. Beeswax is all right for very small fillets, and for finishing out where leather ones come together at the top edge of a rib, when the curve is very small, and for many other places. The wax is prepared by being put in a cylinder, having holes of varying diameter in one end. This is warmed, and the wax forced through with a plunger, and then applied with a warm slicking tool of the right radius. If used too cold, the fillet will not adhere firmly to the wood. In fact, it is hard to lay wax fillets satisfactorily in a cold room, for both pattern and wax are chilled to commence with, and the heated iron bearing on the top surface of the fillet only makes it difficult to communicate the heat evenly enough through the whole mass to secure a firm contact with the wood, and after the pattern has seen constant use in the foundry the wax will peel up badly; also it is not a durable substance for a fillet if sunshine or heat of any kind strikes it to any extent. Putty has always been used in great quantities in pattern making, and probably always will be, on account of its cheapness. Undoubtedly more feet of fillet can be applied in a given time with this substance, for a given amount, taking both the material and labor into consideration, than with anything else, but it is only adapted to cheap work, and not for standard patterns, as it is soft, easily dented, marred, or bruised, besides imparting no element of strength whatever to the work. In some places plaster of Paris is added to it, to increase its durability, but when this is done, it must be used immediately after mixing. Black putty is also frequently used. This is nothing but common putty mixed with lampblack, and is employed only on cheap work, having but one coat of shellac, this being applied after the sand-papery, thus comparing in color with the blacking on the pattern, and saving a second coat.

When fillet are called for having a radius above an inch, then they must be worked out of wood, and this should be done after gluing to the pattern, not before, in order to have the feather edge adhere as firmly to the work as possible. It is almost impossible not to have the edge curl away if cut out first, and then fastened to the pattern, even if the precaution is taken to have the angle of the fillet made slightly greater than that of the corner it fits, in order to cause a binding of the edges.

A mould of any considerable size can be made more safely, quickly, and easily, and with a minimum of labor, where these points have been considered in the design, and carefully followed out in the pattern, and with far more chances for a perfect casting, as the danger of cracks in shrinking has been eliminated. How many castings are spoiled by having some slender part joined to a heavier one, with no fillet where they come together, thus causing a crack by the shrinkage strain at the junction, it would be hard to determine. A pattern heavily rounded wherever possible will certainly leave the sand very much easier and with less danger of breaking the mould, thus saving labor in patching and mending, which is always a form of dead loss to the proprietor on day work, or to the moulder on job work, besides being a great vexation to the workman himself. I would go so far as to say that every edge of a pattern, except on surfaces to be machined later, should be rounded, even if the radius of curvature is so small on some light work that it can be done entirely with sandpaper, and on brackets, ribs, heading, etc., it is much more satisfactory when one gets accustomed to it to have the edges terminate in a semi-circular section, rather than flat with the two corners somewhat rounded. This rounding of outside surfaces is necessarily on the pattern itself, but there is something else frequently not on the pattern that is expected just as much to be on the casting, and that is the fillets. How many moulders can testify to getting patterns with a chalk mark all around every corner and rib, and this injunction in two words, "cut fillets," also marked in chalk somewhere on the surface. Once in a great while a case occurs where this is justifiable, but it should be rare. A moulder does not profess to be a sculptor, and when he is forced to carve out fillets in the sand, who can blame him if, instead of being the radius of a circle, they prove to be the hypotenuse of a right-angled triangle? Then too there are often places in the mould where it is very difficult to do this, without dropping sand down into parts where it is hard work to remove it, and the result will be an imperfect casting.

Another thing I wish to mention in this connection, although it does not show on the casting except by a fin, which must be clipped off before leaving the foundry, is still in the nature of a fillet. When a core is placed in position horizontally, and the cope closed down, the impression made by the core print where it joins the main pattern is liable to be crushed where it enters the body of the mould, unless the moulder shaves off the corner so that, at this juncture, the core does not quite touch the edge. This shaving process is done as a foundry precaution, and varies from a slight amount on small work to, perhaps,  $\frac{1}{8}$  inch or more clearance all round where the core enters the mould, this gradually tapering off to the size made by the core print.

The fact of cores coming in the interior of a casting, and the places made by them being entirely out of sight, is a sort of a "will o' the wisp" to some, who imagine that fillets are unnecessary because they do not show. This is a great error. They are just as much needed here as elsewhere, to strengthen the casting, and to help resist shrinkage strains, and should be put in of a size proportional to the casting to which they belong, but need not be made excessively large, as they frequently are on the outside of a pattern simply for the graceful effect, for these are not seen. Their place is in the core box, and not as a production of the core maker's trowel or file. It will sometimes happen that a fillet is called for, on what is the top or open end of a core box, thus making it impracticable for the pattern maker to provide for it. In such cases the coremaker ought not to object to making it in the sand, and, as it comes within the casting, and is out of sight, a plain flat damper is all that is required, and the fillets already in the core box will be a guide for the size. Another case showing the utility of heavily rounded outlines and fillets on castings is when they undergo the cleaning process, and they will also pickle and peel more freely, as there are no sharp corners for the sand to stick into, and thus time, and the edges of cold chisels, are saved.

As we reach the machine shop, the man who snags

the casting finds no sharp corners full of sand to be scraped out with old files, and as he scours his work down with the coarse emery brick preparatory to painting, he can do much more effective service, for as the stone becomes rounded on the corners with use, it will still clean the large fillets, whereas with sharp corners it could not, and finally, when the iron filler is applied to one of these smoothly outlined castings, it can be sandpapered down easily and quickly, so that, after the painting is completed, the effect, when properly done, is almost like velvet.

#### REDUCTION OF SULPHUR ORE IN SICILY.

At the request of a resident of Missouri, a department instruction was sent under date of October 27, 1898, to the consuls at Catania and Palermo, asking for a description of the methods in vogue for the reduction of sulphur ore. The replies are given below.

##### CATANIA.

There are four different methods employed for the fusion of sulphur ore, known, respectively, as the calcarone, Gill, Fiocchi, and Orlando systems.

The first, the calcarone, is the primitive mode of extraction, and is the one generally used. The kiln is built into the ground to a depth of 6 to 9 feet, the walls being of masonry and cylindrical in form, with a sloping floor of stone and gypsum. When the calcarone, or kiln, is filled, the ore at the bottom is in large pieces, so that there may be no impediment to the "old" (Sicilian term for molten sulphur) running out, and the pieces of ore become gradually smaller until the top of the calcarone is reached. The ore is then heaped up in the form of a large cone and is covered with turf, sand, and refuse from former fusions, in order to prevent loss and protect it somewhat from the elements. During the filling process, several air shafts are placed into the ore, by means of which the fire is communicated thereto, and through combustion of the mineral itself the whole mass melts, this process lasting from ten to twenty days. A small hole is made at the lowest point of the wall, through which the liquidized sulphur runs, and is taken off into square wooden forms, containing from 130 to 170 pounds of sulphur. This is continued day by day, until all the sulphur is extracted. The capacity of the kilns varies from 7,000 to 52,500 cubic feet, and one fusion of a large calcarone lasts three months. One great disadvantage of this system is the damage to vegetation by sulphur fumes. The calcarone is allowed by law to be in operation only from June 28 to December 31.

The second system, known as the "Gill," is by furnaces or ovens built in masonry similar in form to the calcarone, but much smaller and covered with a cupola in masonry. They are generally built and worked in pairs, and each cell or oven contains from 5 to 30 cubic meters (177 to 1,059 cubic feet) of ore. They are, however, also built in batteries of four, and the system is this: After being charged, the ore in one cell is fired and the smoke, instead of passing into the open air, as is the case with the calcarone, passes into the adjacent cell and gradually heats the mineral, until by the time the first cell has finished working, the other has reached such a temperature that the ore ignites and cell No. 1 is again filled; and so the process goes on. The advantage is that the gases, which are heavily charged with sulphur, are not lost, and the percentage of sulphur recovered is considerably higher; further, the time occupied is much less than with the calcarone, the working of each cell occupying from seventy-two to ninety-six hours, according to size; and as very little smoke escapes, the proprietors can work all through the year.

The next system, known as the "Fiocchi" patent, consists of wrought iron cylindrical receptacles, which are suspended by circular flanges and have an inner perforated shell. When the apparatus has to be filled with ore, it is placed in a vertical position and the ore, before being put in, is broken into small pieces; when filled, it is turned in a horizontal position and a steam pipe screwed on. Steam at from 60 to 80 pounds pressure is then turned on, passing into the space between the outer and inner shell and to the mineral through the perforations of the inner shell, and, in this way, reaching all parts of the ore. As the mass of ore is heated, the steam becomes dry, and the sulphur fuses and is run off into proper receptacles.

The apparatus is 4 meters long by 1.20 meters in diameter. Three are worked in a row, each containing 3 cubic meters of ore, and seven fusions are made in twenty-four hours. A steam boiler of 16 horse power is required for the necessary steam. This system is adapted for rich ore or ore that is porous; very hard ore cannot be fused. The percentage of sulphur recovered is much greater than with the calcarone method, with the added advantage that the sulphur ore can be rapidly turned into commercial sulphur. The cost of a plant of this kind being rather heavy, the smaller mine owners prefer the old system of calcarone.

The last is the Orlando system, and is the same as the Fiocchi, except that the apparatus always remains horizontal. Four trains, each loaded with about 15 cwt. of ore, are run in on rails and remain during the fusion. The advantage over the Fiocchi system is the greater facility in charging and discharging the apparatus.

##### SULPHUR REFINING.

All the refining of sulphur, with the exception of one plant at Palermo, is done at Catania. The largest plant consists of four ovens, each containing a battery of ten retorts for refining, capable of turning out 48 tons of refined sulphur in twenty-four hours; four ovens with four chambers for subliming and making flower of sulphur, capable of producing 2,000 tons in a season; and a steam mill with runner edge stones of lava, capable of milling 3,000 half cwt. bags (165,000 pounds) of sulphur per day.

The refining season commences in October and ends in June. The milling season lasts only about four months—say from February to June—and the product is used almost exclusively for the sulphuring of vines. In refining sulphur, a large oven in masonry is used, with an arched roof, upon which are placed the cast iron retorts, which are again covered by another arch upon which are placed cast iron boxes, surrounded by brickwork. Newcastle coal, mixed with wood in order

to obtain an abundance of flame, is used. The fire grate is at the bottom of the oven, and the gases and flame ascend by spiral openings and play around the retorts, and the smoke rises by the flues to the cast iron boxes, and thence to the chimney or stack. The sulphur is put into the cast iron boxes, where it is fused, and by means of a valve it passes into the retorts, where it is transformed into gas; and from there, by a special cast iron pipe, it passes into the condensers, which are cylindrical cast iron vessels. The refined sulphur, which has again become liquid, then passes by a special aperture into cast iron pans, so that it may gain the required temperature, and is then ladled out into cast iron forms of about 1 cwt. (110 pounds) capacity; or, if roll sulphur is required, it is ladled into metallic moulds of the shape usually employed in commerce.

In subliming sulphur, an oven, as described above for refining, is used, but with only two retorts; and the gases, instead of going into the condensers, ascend into a large, specially constructed chamber, lined with bricks, which is hermetically closed, with the exception of a valve in the roof, which opens automatically when the tension produced by the gases is too great for the strength of the chamber. The gases, as they enter the chamber at the necessary temperature, solidify and the sublimed sulphur falls in the form of flakes, like snow, to the ground.

Sulphur of commerce contains from 2 to 5 per cent. of impurities. The lower, dark-colored qualities, such as good or current thirds, are generally used for refining, owing to their lower price.

The total export of sulphur from January 1 to December 1, 1898, was 415,424 tons, of which the United States received 131,678 tons, France 84,369 tons, and Germany 26,727 tons.

ALEXANDER HEINGARTNER, Consul.

Catania, December 27, 1898.

##### PALERMO.

There are at the present time three methods of reducing sulphur ore in this district, viz., the calcaratory furnace "calcarone," the Gill oven, and by s.e.m.

By the first two methods, the fuel used is sulphur in its mineral state, and by the third, pit coal. Reduction by calcaratory furnace is the more general method in use, as the furnace is of easy construction and involves little expense, being operated in the open air and capable of smelting several thousands of tons of ore at a time.

The calcarone is located as near the mouth of the shaft or mine as possible, usually on the side of a hill, in order that when the process of smelting is complete, the sulphur may run down the hill in channels prepared for that purpose, part of the sulphur being burned in the process of smelting, in order to liquefy the remainder.

The calcarone is circular in shape and has a floor with an inclination of from 12° to 18°. The wall around it is made of rough stone cemented with a mortar of gypsum. At the back of the wall, the thickness is some 45 centimeters, increasing to the front, where it is 1 meter or more, according to the diameter.

In the front is an opening, 1.30 meters high by some 30 centimeters (51 by 12 inches) broad, through which the melted sulphur flows. Two walls run at right angles with the circular wall upon each side of this opening, 80 centimeters in thickness, with a roof over them to strengthen the front of the kiln. The stone floor of the kiln is covered with the refuse of a former smelting, called "ginece." The stonework is from 15 to 25 centimeters (6 to 9.3 inches) in thickness and the covering of ginece is some 30 centimeters in depth, this increasing at the lower extremity. The inner side of the wall is covered with a mortar of gypsum. The capacity of these calcarones varies from 100 to 1,000 tons. It requires thirty days to run off a calcarone of a capacity of 300 tons; sixty days for a capacity of 1,000 tons.

The cost of a calcarone with a capacity of 1,000 tons is 1,500 lire, or about \$300 in United States currency.

In filling the calcarone, the larger blocks of ore are placed in the center, forming, as it were, the backbone of the pile, the remaining space being filled with ore much smaller in size. When the calcarone is filled with ore and covered with ginece, the shape or form of the pile is that of a cone, and after being set on fire resembles a small sized volcano. As the liquid sulphur comes from the calcarone, it flows into wooden moulds forming solid blocks, weighing some 100 pounds.

The quantity of sulphur produced by this system during the years 1890, 1891, 1892, 1893 and 1894, as respects the total production of the mines operated, shows the following proportions: 80 per cent., 71 per cent., 65 per cent., 66 per cent., and 63 per cent., respectively.

At the present time, about 20 per cent. of the total production of sulphur in Sicily is reduced by the "Gill" system. Originally, this system consisted of but two rooms or cells, but at the present time four cells are built together. These have usually from 10 to 50 cubic meters capacity. While the percentage of sulphur obtained by this system is greater than by the calcaratory furnace; the quality is said to be inferior. These ovens being built of solid stone masonry, it is claimed that much heat is saved and again utilized by this system of reduction. One cell only being fired at a time, the ore in the others becomes dried out, and is in a much better condition to burn freely when fired, thus saving both time and fuel. The floors of these cells are constructed upon the same principle and of the same material as those of the calcaratory furnace.

Reduction of sulphur ore by steam covers only about 10 per cent. of the production of the mines in Sicily. The boilers or "cookers" in use are of various kinds and forms, some being movable while others are stationary. In those of a cylindrical shape, the ore is placed in a capsule of perforated iron plate inside the boiler. By the more general method, the ore is reduced in small wagons, with perforated bottoms and sides, the steam being conducted through iron pipes. Only a certain quality of the sulphur ore of Sicily—a very small percentage of the production—yields to steam process, and for this reason, it is not probable the reduction of sulphur by steam, as at present utilized, will become general.

By the calcaratory furnace and the Gill system, the fuel used being the crude sulphur, the cost is trifling;



while fuel for steam reduction has to be shipped into the country at a great expense.

The system of reduction by the calcinatory furnace is the oldest known to the sulphur producer of Sicily. It is said to have been the original method employed at these mines centuries ago. Being simple in construction, furnishing its own fuel, and requiring little skill to operate, it bids fair to remain the favorite.

CHURCH HOWE, Consul.

Palermo, April 10, 1899.

#### A VOYAGE IN ANNAM.

In order to visit Hue, most travelers go up directly from Saigon to Tourane by packet-boat. By the advice of the governor I decided to make part of the journey on horseback, so in this way to study the southern coast of Annam, which as yet is but little known. A government boat took me to Baria, where there were horses waiting to carry me to Phan-Tiet, Phan-Ri, Phan-Rang and Nhatrang by the Mandarin road. To tell the truth, the road through the open forest and along the coast is somewhat monotonous, it being often sandy and destitute of attraction. Upon starting from Baria, we passed through the village of Long-Dien, which owns a handsome town-hall, the exterior of which is elegantly decorated with inlaid work, and where one may see some superb columns of shoo-wood. A few hours afterward we crossed the frontier of Cochinchina, and found ourselves in the empire of Than-Thai. Starting from the frontier, the term "Mandarin road" is hardly anything more than a geographical expression, for in reality the road consists now of footpaths scarcely laid out, and now of sand dunes along the sea.

The unfortunate horses become quickly exhausted, and it was often necessary to make a halt in order to give them a breathing spell. It was scarcely possible to make more than two or two and a half miles an hour. However, we were in no hurry, and took delight in viewing all the scenes of Annamite life that the road offered us. And then our entrances into the villages that succeeded each other were replete with picturesque. The village chiefs had been notified by couriers who preceded us that a white man of rank was to pass through, and so a crowd came in great pomp to meet me. Some of the chief men of the place, preceded by carriers of many-colored banners and a huge tom-tom, bade me welcome, and I was unable to resume my journey until I had undergone the ceremony of the "laga." The notables knelt, raised their arms heavenward, and then threw themselves forward with their foreheads in the dust, and would have continued this performance indefinitely had I not taken care to put an end to it as quickly as possible by impatient cries of *thoi! thoi! stop! stop!*

As soon as we reached the village, the beater of the tom-tom struck his instruments with vigor, so as to assemble the coolies who were to carry our baggage to the next halting place.

It thus took us three days to reach Phan-Tiet, a very important commercial center, and the most populous city of Annam, but one which, I know not why, remains almost ignored. After a rest of half a day, I resumed my journey, and again made the acquaintance of the interminable Mandarin road. After two days in the saddle, I reached the outskirts of the post of Phan-Ri. Here a pompous reception was prepared for me by the Quan-an, an intelligent functionary of Annam, who knew Paris from having been there at the time of the Exposition of 1889, and who anxiously asked news concerning the great iron house. After giving him the required information conscientiously, I asked him to have me taken as soon as possible to the lodgings that had been set apart for me. He said that he would take me thither himself; and an imposing cortege was immediately organized. At the head of this there were two carriers of the banner of Annam, and then followed a soldier bearing a large saber. I came next on horseback, flanked by two men who protected me with two large red umbrellas. In the rear followed the Quan-an, in a palanquin, accompanied by a suite of notables.

a large sum in the work of irrigation. An army of coolies is occupied in digging a huge canal that is to traverse the entire concession and from which will branch a multitude of other and smaller canals.

The trip from Phan-Rang to Nhatrang requires twenty-four hours; but in this part of the journey the country becomes very beautiful, and it is a genuine pleasure to follow the verdant valley that meanders between fine wooded hills where, unfortunately, tigers multiply with alarming rapidity.

Nhatrang is a delicious little post at the seaside, on a quiet and picturesque bay, which might become a most agreeable bathing resort. It is here that Doctor

basins, such as the basins of the Ganges, the Tigris and Euphrates, and the Nile; and this has been due not only to the supply of water for irrigation, but of clay for potting.

CHALDEA.

Chaldea, later known as Babylonia, was architecturally and artistically, if not also commercially and politically, entirely a creation of the potter. Juvenal (x. 171) says that "Babylon was a city protected by potters;" Ovid (Met. iv. 58), that "Semiramis raised up the proud walls of Babylon with baked bricks;" and Ezekiel (xxiii. 14), that "men [were] portrayed



THE TOWN-HALL OF LONG-DIEN.

Yersin, the distinguished and modest scientist who discovered the bacillus of the pest, has established a branch of the Pasteur Institute.

Nhatrang is destined to assume a great importance in a near future. It will, in fact, certainly profit by the proximity of the plain of Lam-Liang, where the governor-general intends to install the great sanitarium of Indo-China.

After three days of rest, I with difficulty tore myself away from the cordial hospitality of M. Rauseau, the resident consul, and took passage on the packet-boat of the Compagnie des Messageries Maritimes for Tourane.—H. Turot, in *Le Monde Illustré*.

#### POTTERY AS A HISTORICAL DOCUMENT.\*

WHEN I was invited to open this exhibition, I was asked to deliver an address on the history of pottery. Although I had at hand to help me the late Prof. Middleton's admirable article on "Pottery" in the "Encyclopædia Britannica," and Messrs. Sparkes and Sandys' recently published volume on "Pottery: their Arts and Crafts," that was rather an unmanageable subject to deal with in about twenty minutes, and what I have determined to do is, before dealing with the present position and future prospects of the potting industry in Staffordshire, to say a few words on the

upon the walls of the palaces of Babylon, the images of the Chaldeans portrayed with vermilion." The modern excavations of Layard at Nineveh and Babylon, and of Dieulafoy at Susa, have confirmed these literary references to the immemorial tradition of the prodigious production of bricks and other fictile wares in Babylonia, and of the perfection there attained in the decoration of public buildings with tiles, and large slabs graven, or incised, or molded with illustrations of current events, and painted over in enamel with the most brilliant colors. But the most remarkable creations of the potter's craft in the valley of the Tigris and Euphrates are the tablets, inscribed in cuneiform characters with the chronicles of the rulers of Assyria and Babylonia, and with the religious conceptions and beliefs, and the memoranda of the daily lives and business transactions of their people. The record tablets of Assyria provide an unbroken and minutely detailed chronicle of the declining decades of the old empire, and of the whole period of the new empire to its confused close, that is, from B. C. 900 to 607. For Babylonia the chronicle texts reach continuously back from the sixth century B. C. to beyond King Khammarabi, who first brought all Babylonia under one rule, B. C. 2376-33. But casual tablets carry us far beyond the latter date. A cylinder of Nabonidas, B. C. 556, assigns to a predecessor, Naraim Sin,



A HALT UPON THE WAY TO PHAN-TIET.

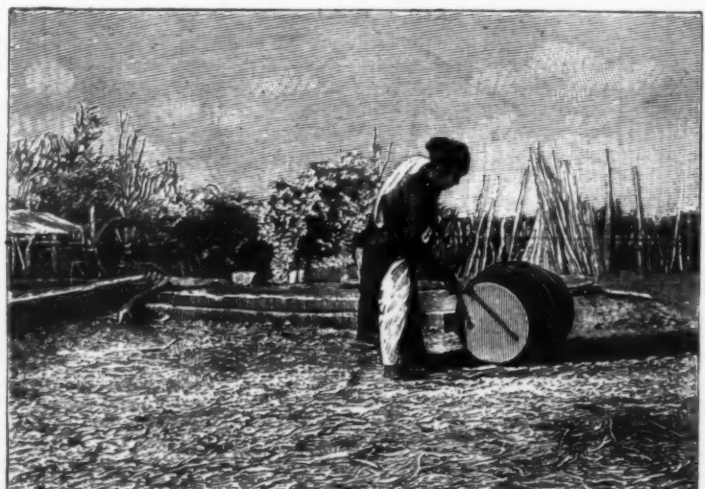
It was in this sumptuous style that, without the least pride, I passed through the quiet, narrow streets of Phan-Ri in order finally to reach an old and tolerably clean pagoda, in which I passed the night.

At the dawn of the following day, I resumed my route, which was always quite monotonous, and, in two days, reached the post of Phan-Rang. Here I had the pleasure of visiting the first important agricultural exploitation that I found in Annam—that of M. Perignon.

M. Perignon having obtained a grant of 30,000 acres, immediately set to work to make it profitable. He purposes to cultivate rice solely, and has already spent

overwhelming magnitude of the debt of the whole civilized world to the potter's craft, in providing us with the very earliest, the most continuous, the fullest, and the most authentic of the contemporary records that have come down to us from "the dark, backward, and abyss of time" of all the historical states of antiquity. Pottery was the oldest and most enduring of the arts, and with basket-making and weaving, marks in every country the first dawns of civilization. All the initial civilizations have arisen in great river

\* Address delivered by Sir George Birdwood in opening the Industrial Exhibition at Clough Hall, near Stoke-on-Trent.—From the *Journal of the Society of Arts*.



THE TOM-TOM FOR CALLING COOLIES.

a date of 3255 years before his own, i. e., the date of B. C. 3755. At first this abysmal date was received with natural skepticism; but some years ago an American exploring expedition unearthed at Nippur, at a depth of thirty feet below the surface of the soil, the platform of a temple, all the bricks of which were inscribed with the names of Narain Sin and his father, Sargon I.; while below this platform they excavated the debris of older buildings, down to the depth of another thirty feet; the inference being that the oldest buildings constructed on the spot cannot be assigned a later date than B. C. 7000. At all events the pottery of Babylonia affords conclusive evidence of the actual



beginnings of art and artistic culture in Mesopotamia centuries anterior to B. C. 4000. But not only the whole chronicle history, but the whole religious literature of the Babylonians has come down to us indelibly scripted on these imperishable burned tablets, of which almost every city, the ruins of which have so far been explored, appears to have possessed an edition of its own.

## EGYPT.

Pottery in Egypt goes back to as primeval a period as in Chaldaea, and at a very early date reached the highest perfection in the form of unglazed bricks, un-

and Anterior Asia; and one of the greatest services rendered by the potter to the history of art has been to prove, within the present generation, that while Hellenic art certainly received certain impulses, and a variety of decorative motives, from both Mesopotamia and Egypt, there existed in Greece centuries before the Dorian invasion (circa B. C. 1100) a highly developed indigenous art, which, in the traditions it provided of the close study of nature, and of refined technical methods, laid the solid foundations of the Hellenic art of Greece, as it began to assert its independent individuality between the eighth and seventh centuries, and reached its perfection in the fifth and fourth cen-

tion is characteristically marine, and some of its conventional motives were conveyed, in the course of the prehistoric amber trade of Europe, into the countries of the Baltic Sea and German Ocean, where centuries afterward they reappeared as "The Three Legs of Man," and "The Celtic Knot." The jewelry is, as already said, wrought with the utmost skill, while the pottery, in the best baked ware, is found fully developed in color, glaze, and varnish. In the Iliad and Odyssey many of the lesser objects of industrial art are mentioned as the work of the Phœnicians; but the nobler ones are ascribed to the gods, that is to the forgotten and mythologized artists and artificers of "Mycenæ the Golden [*πολλύχρυσος*]." The Iliad and the Odyssey were, indeed, the only links between the Ægean art of prehistoric Greece and the Hellenic art of Phidias and Praxiteles, until the recent excavations of the Acropolis, below the debris of the buildings erected on the sacred hill after the destruction of Athens by the Persians B. C. 520, led to the discovery of the immense collections of the remains of primitive Hellenic art that had lain there buried and undisturbed for over two millenniums. After this date there was a rapid evolution of Hellenic art, the chronology of which, from first to last, is always to be most clearly and fully traced in the fictile wares of the Greeks, that is in their painted vases, which, including many of the so-called Etruscan vases, also afford us the most complete descriptions we possess of the costume, manners, and customs, and whole social life, and also of the religion and mythology, of the Greeks.

## ROME.

Glancing at the native pottery of Italy, in so far as it throws any light on the ancient history of that country, I would briefly refer to the excavations of the terramarine village of Castellazzo di Fontenallato, where a rustic crematorium was found, having beside it a platform with a number of urns, containing the ashes of the dead, arranged on it in a four-square order, with dividing cross gangways, after the ground-plan of the villages of primitive Italian and all antique cities. This is one of the most pathetic and suggestive relics of primitive Europe. I will only add, under this head, that the remains of Roman pottery indicate to us more exactly than any of the literary records of even so comparatively late a date, what were the real limits of the Roman Empire, so far as its intimate civilization spread beyond the boundaries of Italy.

## BRITAIN.

There was a vigorous native art in Britain before the Roman conquest of these remote and fog-banked islands, an art of the nature-loving Ægean type, and undoubtedly indirectly inspired by the Ægean art of Mycenæ; but such was the predominant force of the Roman invasion on southern and southwestern Great Britain, that our indigenous rustic pottery was at once replaced by the so-called Samian ware, the fashion of which was imported, as Pliny tells us, from the island of Samos into Etruria, and was afterward imported by the Romans into whatever still savage countries they carried their ever-victorious standard. But our native industrial arts found a timely and safe refuge in Scotland and Ireland, where the practice of them slowly developed those distinctive Celtic arts which, as Rome declined and at last fell, re-issued from their reinvigorating retreats, and, as modified by Byzantine [including so-called Saracenic] art, flourished for centuries over all Western and Northern Europe, and even re-acted on the arts of Byzantium.

## THE FUTURE OF BRITISH POTTERY.

The advances made in British pottery during the past 150 years have been remarkable, and the improvement in its artistic quality since the Great Exhibition of 1851 has been truly wonderful. That exhibition gave an extraordinary impulse to all the artistic industries of the United Kingdom, excepting jewelry; and in none of these industries have the resulting ef-



MIRADOR IN THE ENVIRONS OF BARIA.

glazed and glazed tiles, glazed scarabs, and other images of the gods, richly enameled plaques, and painted vases. The pyramid builders of the IV. Egyptian Dynasty, B. C. 3751-3998, were the contemporaries of Sargon I. and Naraim Sin in Chaldaea. Very beautiful also are some of the doorways, built up of enameled tiles, of the tombs and temples of the XIX. Egyptian Dynasty, in the thirteenth and fourteenth centuries B. C.; and very valuable in many ways was the Egyptian fashion of representing in their vase paintings every type of the human races known to them, with the details of the clothing and jewelry worn by them, and of the arms they carried. In this respect we are indeed under as deep an obligation to the Egyptian potter as to the Assyrian sculptors of the so-called "Nineveh Marbles." But the history of Egypt was never intentionally recorded in pottery, as was that of Babylonia; and we only become dependent on pottery for Egyptian history where the stone monuments of the country have disappeared, as in the Delta; and the only light we obtain from the vast mounds of broken tiles and vases that exist there is casual and disconnected. The earlier Egyptian dynasties ruled from capitals without the Delta, from Memphis (just at its apex) Elephantine, throughout which prolonged tract the river Nile is huddled in on either side by rocky hills, precluding, therefore, any temptation to destroy the earlier monuments for the construction of later buildings. On the other hand, the XXVI. Dynasty, founded by Psammetichus I., in the seventh century B. C., had its capital at Sais, well within the Delta, where nearly all the stone monuments set up by Psammetichus I., and Pharaoh Necho, and Pharaoh Hophra, and their successors, have been used as quarries for providing the Arab devastators of Egypt with materials for building the cities of Rosetta, Damietta and Cairo. On the other hand, the Delta being rich in clay, it became from a very early period a great center and market of the potter's industry; and the site of the Greek colony founded at Naukratis during the reign of Psammetichus I. has been identified, and its internal economy and external trade, and its whole history traced by means of the painted and lettered potsherds found among its ruins. This city, so rich in the remains of the fictile arts and crafts of the Greeks, is also deeply interesting to all Englishmen, as the first fruit of the free trade policy, initiated by Psammetichus I., of throwing Egypt open to foreign settlers. The similar policy adopted in the same seventh century B. C. by Nebuchadnezzar II. gave its first great impulse to the sea-borne traffic of Babylonia with Persia, Arabia, Western India, and the east coast of Africa; and this enlarged commercial intercourse between the countries of the Indian Ocean gradually joining hands across the Isthmus of Suez with the active mercantile enterprise pursued by the Greeks in succession to the Phœnicians, along the coasts of the countries of the Mediterranean Sea, at last that great historical trade was established between Southern Europe and Southern Asia which flourished almost uninterruptedly from the seventh century B. C. to the rise of the devastating Saracenic power in the seventh century A. D.

## GREECE.

As the "go-a-ducking Phœnicians" were the first intermediaries in the trafficking between the peoples of the Mediterranean countries, and were later supplanted in this coasting trade by the "cogging Greeks," the latter were, until very recently, supposed to have received the first inspiration of their arts from Egypt

and Anterior Asia; and one of the greatest services rendered by the potter to the history of art has been to prove, within the present generation, that while Hellenic art certainly received certain impulses, and a variety of decorative motives, from both Mesopotamia and Egypt, there existed in Greece centuries before the Dorian invasion (circa B. C. 1100) a highly developed indigenous art, which, in the traditions it provided of the close study of nature, and of refined technical methods, laid the solid foundations of the Hellenic art of Greece, as it began to assert its independent individuality between the eighth and seventh centuries, and reached its perfection in the fifth and fourth cen-

tures B. C., and that the influence of this pre-Hellenic art of Greece not only dominated the immigrant Hellenes, but asserted its influence over Europe, far beyond the limits of Greece, to the very shores of the Baltic Sea and the German Ocean. In 1868 Schliemann made his marvelous discoveries in the prehistoric mound at Hissarlik in the Troad, and in the prehistoric ruins at and about Mycenæ in the Argolid. These discoveries included not only figulines, but all sorts of objects of art, of which the most sensational were, of course, the jewelry of elaborately wrought gold. Schliemann thought he had broken into the treasuries of Priam and Atreus, and laid bare the very bones of Agamemnon. But he had done something much more important in the elucidation of the history of European art, for his discoveries—confirmed as they were by the discovery of similar figulines at Ialysus in Rhodes, in the islands of Thera, Naxos, and Paros, and throughout the Cyclades, in Cyprus, in the Mycenaean cemetery at Thebes, in the temple of Apollo at Delphi, in the neighborhood of Athens, and, sporadically, over all Greece—demonstrated that an indigen-



ENTRANCE OF THE PAGODA AT PHAN-RI.

ous civilization, capable of the highest artistic achievements, had preceded the primitive Hellenic civilization of Greece, and that in its beginnings it must have extended back to the very verge of the neolithic night of Europe; and that after it was suddenly blotted out by the Dorian invasion of Greece, circa B. C. 1100, the tradition of it still remained a living artistic force in Greece, and irradiated the stories of the Iliad and the Odyssey with their after-glow. This Mycenaean or, as it is now called, Ægean art culminated in the fifteenth century B. C., and was, therefore, contemporary with the later Pharaohs of the XVIII. and the earlier Pharaohs of the XIX. Egyptian Dynasties. Its ornamenta-

ments have been so beneficial and momentous as in pottery; the redeeming grace of our pottery, in all its numberless local variations, being the distinctively British love of nature, and of the study of nature in the harmonious combination of decorative forms and coloring, which can nowhere be artificially combined more felicitously than in pottery. Never was the pottery industry of this country more healthful and active than at the present time, and there is before it an immediate future of unbounded prosperity. Its artistic superiority, in its simple naturalness and dexterous technique, over the pottery of all other European manufacturing countries, was being everywhere recognized, and the



demand for all classes of British pottery was every year increasing in the United States, and the other English-speaking nations of the New World and the Old. Apart from this, pottery was coming into growing demand for many purposes to which it had never before been generally applied in this country. The National Liberal Club, in Whitehall Place, London, was an illustration of the pleasing effects to be obtained by covering the walls of ordinary living-rooms and house passages with enameled tiles. In the Brompton Road, London, a house is now being completed, the whole front of which is covered with enameled tiles of deep-toned brown. Nothing can be more magical than the play of the slanting shafts of the light of sunrise and sunset on these tiles. The Birkbeck Bank in Southampton Buildings, off Holborn, London, is being entirely renewed in polychrome pottery, not only the ornamentation, but the entire architectural construction, so far as it appears externally, of the building being rendered in variously and vividly colored enameled terra-cotta. Of course, pottery readily yields itself to excess of elaboration in decorative details, and some will possibly feel that this has happened with the Birkbeck Bank, both in the plastic ornamentation and the coloring of the building; but, none the less, it is a hopeful illustration of what can easily be done to render the streets of London, and other smoky cities of the United Kingdom, as clean, and bright, and cheering in the future, as at present they are dirty, dull, and depressing. The greater part of London, and of Manchester, might rapidly be rebuilt in enameled terra-cotta, and with the finest effects of both foreground and distance, and with the most charming flamboyance of softened coloring along the skylines. In Lambeth both scenic stoneware and earthenware are now being largely introduced in the internal decoration of public houses. The tap-room of one of them has lately been lined with a polychrome representation of the Lambeth bank of the Thames one hundred years ago, showing the house as it then stood. Nothing could be more attractive. There is, of course, no limit to the potential demand for enameled tiles and decorative stoneware for these and similar applications. The internal decoration of St. Paul's also at once suggests how profitable it would be for the potters of this country to take up the manufacture of earthenware and stoneware, if not of glass, mosaic cubes or "tesserae," for the external and internal decoration of public and even private buildings. A great outcry has been raised against the decoration of St. Paul's with mosaic. The practical answer to it is to visit the Cathedral as the work progresses, and I am glad to say that it is progressing without interruption, and to see it in the varying lights and shades of dewy morn and dusky eve and unclouded midday. Words cannot describe the stately splendor of the magnificent and enchanting vision that rises before you in the choir—divine in art of color and design; and when the whole work is completed, this achievement of the self-denying piety of the Dean and Chapter of the Cathedral, and of the genius of Sir William Richmond, will be regarded in all future time as the crowning architectonic glory of Victorian reign. That the outcry against it should have received any semblance of official support is nothing short of a national scandal.

I have said nothing of the use of unglazed tiles and unglazed terra-cotta mouldings in house building and decoration. There are two highly ornamental chimney-pieces, of dull brick-red terra-cotta, almost as hard, to all appearance, as unpolished jasper, in the Council Reading Room of the India Office, which deserve more attention from architects and decorators than they have received; and the Science Schools, at South Kensington, and the Natural History Gallery (British Museum), opposite to it, are two notable examples of buildings of unglazed terra-cotta. But the objection to its use in both these examples is that it is intentionally made to simulate stone, with the result of painfully disillusioning the admiring student of the noble architectural frontage of the latter building when once the imposition is exposed. The deception in this building is the more difficult of detection owing to the "bonding" of the terra-cotta blocks after the manner of stone masonry.

There is another application of pottery, in the production of bright, showy trinketry. The Egyptians were great adepts in it, enhancing the brilliance of the variegated enamels used in the first firing, by leaving depressed points on the surface of the objects [usually of a prophylactic, phalacerial, or talismanic character], into which fragments of richly-colored glass were fixed, and fused by a second firing. Gayly painted, and carefully modeled in the minutest details, this dainty trinketry was in design and subtlety of artifice a triumph of the potter's craft, and, indeed—to say so without offense—of his craftiness. Stoke might do much in this way to cut out Birmingham, and there would be nothing of the tarnish of "imitation"—of "Brummagem"—about such figural jewelry.

#### THE ARTISTIC EDUCATION OF THE ARTISAN.

To secure this future, the indispensable requirement was to advance in every way the technical and artistic education of the British potter. That is too large a subject to treat fully in bringing my remarks to a close. I will only say on the point that it is as true of pottery as of all other artistic industries, it is indeed more true, as clay responds so readily to one's mental suggestions, that the skill of the artisan can be perfected only in the education—the drawing out—of his artistic ideals; and that two things are essential to this. The first is to intimately familiarize the potter with the best examples of his art, and, above all, with the masterpieces of the Greek potters. One has to insist on this in an unhistorical age, in which men are apt, in their degrading ignorance of tradition, to rely too exclusively on their technical proficiency, and overweening conceit of themselves. The second essential, and still greater thing, is fortunately innate in all the Aryan races, and deeply implanted in the British races, and that is the simple love and diligent study of nature; the love of our green hills and dales, of the bright flowers of our fields and lanes, the birds that fill our rejoicing skies with song, and the shells and other strange sea things the surging waves wash up on our shores, the colors of sunrise and sunset, and the jeweled constellations of the midnight heavens. The love of these things must be fostered in every way; for, quoting from Longfellow, whose *Keramos* this ex-

hibition and its neighborhood have vividly recalled to my memory:

"Art is the child of Nature; yes,  
Her darling child, in whom we trace  
The features of the mother's face,  
Her aspect and her attitude,  
All her majestic loveliness  
Chastened, and softened, and subdued  
With a more attractive grace,  
And with a human sense imbued.  
He is the greatest artist then,  
Whether of pencil or of pen,  
Who follows Nature. Never man  
As artist or as artisan,  
Pursuing his own fantasies,  
Can touch the human heart, or please,  
Or satisfy our nobler needs,  
As he who sets his willing feet  
In Nature's footprints, light and fleet,  
And follows fearless where She leads."

#### METHODS OF DETERMINING THE FREQUENCY OF ALTERNATING CURRENTS.

By CARL KINSLEY, M.E., in The Electrician, of London.

THE engineer may wish to obtain a cyclical variation of the speed of an alternator; or possibly the

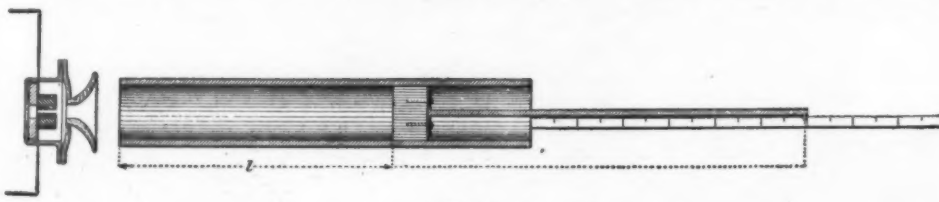


FIG. 1.

exact determination of the changes of speed due to sudden variations of load may be of great importance. An experimenter with alternating currents always needs immediate and correct values of their frequency. It will be of interest to give a review of the methods that have already been used, and to suggest a new method that is easy to use and that may be employed with an error of less than one-fourth of one per cent.

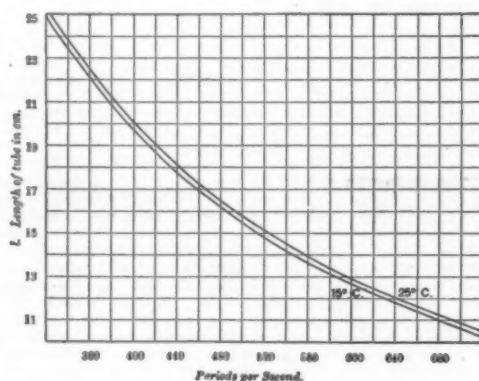


FIG. 2.

The first method one considers is that of a synchronous motor and a speed indicator. If the timing is done with a watch, there is an unavoidable error of at least two per cent., and the value obtained is the total number of revolutions for, say, half a minute instead of the instantaneous value. A second method is one that has been employed by Prof. S. P. Thompson.\* Several turns of wire are placed about the wire carrying

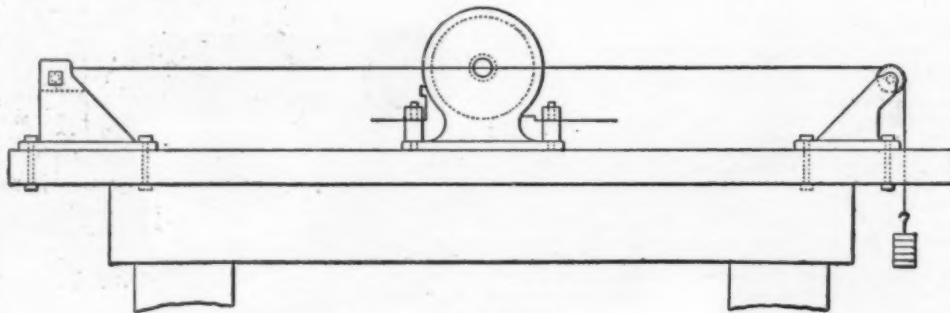


FIG. 3.

the alternating current. A hand telephone connected to these turns then gives a note which has twice the periodicity of the alternating current. If a tuning fork of known period, which is about the same as that of the alternating current, is now sounded near the telephone, there will be heard a succession of beats which in number will equal the difference in frequency between the telephone and the tuning fork. For instance, let

$f$  = number of complete vibrations per second = 240.

$b$  = number of beats per second = 2.

$n$  = telephone frequency.

$p$  = alternator frequency.

Assume that the frequency of the fork is less than that of the telephone. With a little practice it is easy to tell whether the frequency is greater or less.

$$n = f + b = 242.$$

$$p = n/2 = 121 \text{ periods per second.}$$

\* Proc. Phys. Soc., vol. xiv., p. 270.

The difficulties with this method are that the forks of sufficiently slow period for the frequencies now commonly used are unwieldy, and the range that can be covered by a single fork is very limited.

A third method that has many advantages employs the resonance of an air column as the frequency indicator. A telephone is made to respond, either directly or by induction, to the alternating current. It is found that the fundamental of the telephone has a periodicity equal to that of the alternating current. There are also present all of the harmonics in succession up to the thirty-fifth, in some cases.

Fig. 1 will show how an air column may be made to respond to these notes. (A 1.5-inch drawn brass or glass tube is used. Internal diameter = 3.45 cm.) From the observed lengths of the air column find from the curve, Fig. 2, the periodicity of two successive harmonics. The greatest common divisor of the periodicities will be the frequency of the fundamental, which is the frequency of the alternating current. As an illustration:

Temperature 25° C.		
Length Giving Resonance.	Frequency of the Harmonic.	
19.1	420.0	(1)
16.5	480.0	(2)

The greatest common divisor is 60. Hence the alter-

nating current has 60 periods per second, or 7,200 alternations per minute. No. 1 is then the 7th and No. 2 the 8th harmonic.\* After the number of a harmonic is known, then it can be used alone to determine the variations in the frequency of the alternating current. This method can be used with an accuracy of one-half of one per cent., and is of great service, as no preliminary calibration of apparatus is needed. It is inconvenient in that the temperature must be taken, and being a sound method, upon the skill of the observer depends the accuracy with which it can be used.

A fourth method is one proposed first by Profs. Ayrton and Perry.† This includes an iron wire that is set into resonance by an electromagnet which is energized by the alternating current. The periodicity of the wire can be varied by changing the stretching load. Fig. 3 shows an arrangement of the apparatus. The period of the vibrating wire can be obtained from the equation‡

$$t = 2l\sqrt{\frac{\pi r^2 \delta}{T}} \dots \dots \dots (1)$$

$t$  = time of one complete vibration in seconds,

$l$  = length of the string in centimeters,

$r$  = radius of the string in centimeters,

$\delta$  = density of the material,

$T$  = stretching load in dynes.

Some of the difficulties accompanying the use of this method are mentioned by Lord Rayleigh.§ The periodicity cannot be determined with precision without a refinement of apparatus and manipulation—including temperature determinations and calibration of the wire—that makes its use inadvisable.

A fifth method was proposed by Mr. Albert Campbell, who used a vibrating iron strip, whose periodicity was varied by changing its length. Fig. 4 gives his arrangement of apparatus. The length of the strip was changed until the rod vibrated in synchronism with the alternating field of the magnet. The periodicity of the rod can be computed from the equation¶

$$t = \frac{2\pi P}{k\delta m^2}$$

$l$  = length of the bar in cm.,

$k$  = radius of gyration,

$r$  = thickness,  $r^2 = 12k^2$ ,

$\delta$  depends on the material of the bar,

$m$  is an abstract number.

This equation may be written—

$$t = \sqrt{B/P/T}.$$

For band iron rods,  $\sqrt{B} = 1.459 \times 10^{-5}$ .\*\*

\* A more complete discussion of this method, giving correction tables for various temperatures and sizes of tubes, I have published in the Phil. Mag., April, 1898.

† See The Electrician, vol. xxiii., p. 219.

‡ "Theory of Sound," by Lord Rayleigh, second edition, p. 190.

§ "Theory of Sound," second edition, p. 184.

¶ Phil. Mag., August, 1894.

\*\* "Theory of Sound," second edition, p. 273.

\*\*\* "Theory of Sound," second edition, p. 274, gives the equation for steel rods  $t = 1.122 \times 10^{-4} P/T$ .



For tool steel I have found the value  
 $t = 1.003 \times 10^{-5} p^2 / r$ .

In order to get absolute values it is necessary to determine the constant as is explained in connection with the following method:

The constants for iron are very nearly the same for different specimens, while in the case of steels they vary widely. If exact values are desired it is not sufficient to use the equation, but the periodicity must in the first place be determined directly for varying lengths on account of the uncertainty in regard to the modulus of elasticity. By this method determinations cannot be made quickly, as the changes of length must be made with great care, for the least difference in the way in which the bar is clamped makes a large difference in the periodicity of the bar. The position for resonance must be sought for with great care on account of the effect of small changes of length. A bar 5.36 cm. long, 0.056 cm. thick, and 0.94 cm. wide will have a periodicity of 16,100 periods per minute. A change in length of only 0.007 cm. gives a change of  $\frac{1}{4}$  of 1 per cent. in its frequency.

The sixth method is one that I have been using for about a year, and I find it free from most of the difficulties and errors of the preceding methods. A flat iron bar is made to vibrate in unison with the varying field of an electromagnet energized by the alternating current. This is accomplished by varying the periodicity of the bar by means of a non-magnetic rider.\* Fig. 5 shows the arrangement of the apparatus. The principal advantages are seen to be: 1. The invariable condition of the bar on account of its unchanged length. 2. The sensitiveness of the resonator can be changed at will by varying the mass of the rider. 3. The adjustments can be made with such rapidity that practically instantaneous values of the periodicity can be obtained. 4. The determination can be made without special skill with an error of less than  $\frac{1}{4}$  of 1 per cent. I have found that thin rods are most easily used. If, then, a rod of band iron is employed 7.7 cm. long, 1 cm. wide, and 0.056 cm. thick, with a rider of 0.27 gramme, then Fig. 6 will show the relation between the distance of the rider from the fixed end of the bar and the alternations per minute of the alternating current. If, for instance, the rider stood at 6 cm. when the rod was vibrating synchronously with the alternating current, the frequency of the current would be 7,195 alternations per minute. The difficulty that accompanies the use of this method, in common with the two preceding, is caused by the trouble necessary to get the calibration curve for the particular rod being used. The curve may be obtained either by calculation or experiment, as follows. For the lateral vibration of a bar loaded at the end Lord Rayleigh proposes the equation which was obtained by means of a series of approximations.†

$$\frac{1}{p^2} = \frac{p}{3q\pi^2\omega} \left( m + \frac{33}{140} \rho \omega l \right) \dots \dots (2)$$

$p$  = number of complete periods per second.  
 $l$  = length of bar in centimeters.  
 $q$  = (Young's modulus) modulus of elasticity.  
 $\omega$  = radius of gyration of the bar about an axis perpendicular to the plane of bending.  
 $h$  = width of the bar in centimeters.  
 $\omega$  = cross section of the bar in square centimeters.  
 $m$  = mass of the rider in grammes.  
 $\rho$  = density of the material of the bar.

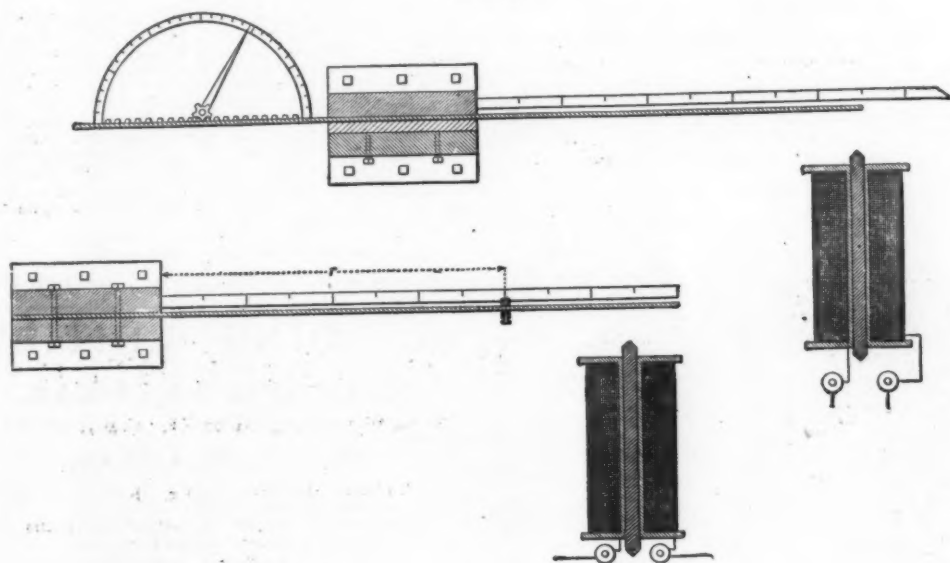


FIG. 4.

FIG. 5.

If the rider is not at the end of the bar, the equation may be written

$$\frac{1}{p^2} = \frac{1}{3q\pi^2\omega} m r^2 + \frac{33}{140} \frac{\rho}{3q\pi^2} l^4$$

$r$  = distance of the rider from the fixed end of the bar.  
 Also let  $r$  = thickness of the bar in centimeters.  
 Then

$$x^2 = \frac{1}{12} r^2$$

$t$  = time of one complete period.

For iron bars the equation becomes

$$t^2 = A \frac{m r^2}{h^3} + B \dots \dots (3)$$

\* Since writing this paper I have found that Prof. Ayrton and Perry, while using the vibrating string method, employed a magnetic tongue, whose moment of inertia was varied, and a method was employed. This method was apparently neither used nor fully described.

† "Theory of Sound," second edition, vol. I, p. 284.

The values of  $A$  and  $B$  will be given, and then, for any particular bar using a single rider, the equation may be written

$$t^2 = C r^2 + K \dots \dots (4)$$

I have experimentally verified the equations determining the time of a period,  $t$ , by autographic chronographic records.\* The experimental work is too extensive to be given in this paper. The results are of great interest, as they give the modulus of elasticity of bending, instead of Young's modulus, which is usually employed.

It is sufficient to say that the period of vibration of every bar can be obtained from equation (3) for all values of  $m$ ,  $r$ ,  $h$ , and  $l$ , as soon as the constants  $A$  and  $B$  have been found. The error due to the approximations is not greater than  $\frac{1}{10}$  of 1 per cent. Band iron is a convenient material, and for the four specimens

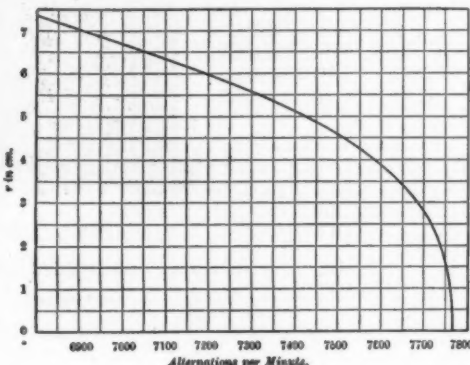


FIG. 6.

tested, varying in thickness from 0.0285 to 0.115 cm.,

$$A = 1.17 \times 10^{-10} \quad B = 2.13 \times 10^{-10} \quad A/B = 0.549.$$

The ratio  $A/B$  is independent of the modulus of elasticity, and consequently it can be employed in the experimental determination of the constants for the particular rod that is to be used. If, for instance, we consider the rod mentioned in connection with Fig. 6. When no rider is used ( $r = 0$ ) it is found that

$$t = 0.01546 \text{ sec.} \quad t^2 = K = 2.39 \times 10^{-4}.$$

From the preceding equations it is found that  $C$  of equation (4) can be obtained by substituting in the following equation the dimension of the rod being used, as follows:

$$C = 0.549 \frac{K m}{h^3 r^2} = 1.80 \times 10^{-7}.$$

Equation (4) becomes

$$t^2 = 1.80 \times 10^{-7} r^2 + 2.39 \times 10^{-4} \dots \dots (5)$$

The alternations per minute =  $120/t$ .

Equation (5) was thus used in getting the calibration

## FLUORSPAR MINING.

FLUORSPAR occurs in the United States only in Crittenden County, Kentucky, and Hardin County, Illinois. It is found in veins in connection with limestone and yellow clay, a small amount of lead, calc spar and feldspar being present. The fluorspar found in Kentucky is a pure white massive variety, and is found in veins ranging from 6 to 30 feet in width and varying greatly in length. The largest vein so far discovered in the State is owned by the Fluorspar Company, of St. Louis, Mo., and is known as Mine No. 1. It is situated on the side of a hill and runs almost due north and south from 25 to 50 feet below the ridge. It has been prospected a distance of over 1,200 feet, and the width varies from 15 to 30 feet. In this case the spar is found from the grass roots down.

The main shaft on this vein is 13 feet square and has reached a depth of 96 feet. At this level two drifts, each 6 feet high by 7 feet wide, are being run north and south along the vein, cutting through an almost solid mass of pure white fluorspar. Heavy timbers are necessary to support the roofs. When a drift has been run far enough, a narrow track is laid, upon which small four-wheeled flat cars are run. The buckets are placed on these, and when loaded at the end of the drift are wheeled to the foot of the shaft. They are then hoisted to the top by a horse power whim, so arranged that while one bucket is being brought up, another is going down.

Upon reaching the top the bucket is put on another car, wheeled to the sorting and cleaning sheds, dumped and returned for another load. At the sheds the spar is taken in hand by the sorters, hackers, screeners and barblers. The large pure white lumps from 5 to 150 pounds in weight are first selected and turned over to the hackers, who chop off with hatchets the small amount of dirt adhering. It is then graded as No. 1 pure white lump fluorspar and is used for the manufacture of hydrofluoric acid and for grinding and for the use of glass manufacturers, enamelers, etc. The slightly off or mixed colored lumps are also separated and cleaned, and known as lump fluorspar. This grade is used by steel manufacturers.

After taking out the large lumps the spar passes to the screeners, who separate the fine or gravel spar from the crushed or small lump fluorspar by the use of coarse screens. The crushed fluorspar is passed to the barblers, who grade it into Nos. 1 and 2 qualities, according to color and at the same time barrel it. When filled the barrels are headed up and loaded into wagons or placed in the warehouse. Barreled fluorspar is also used by acid makers, iron and steel manufacturers, blast furnaces, foundries and furnaces. Very little fluorspar of any grade is kept at the mines; it is hauled to the railroad and loaded on the cars or stored in the warehouse and on platforms as fast as it is taken out.

The demand for all grades of fluorspar has been steadily increasing during the past year, as the iron and steel makers are beginning to realize the benefits derived from its use.

Besides the above described Mine No. 1, the Fluorspar Company is developing mines Nos. 2 and 3, which bid fair to equal No. 1. The company also owns or controls 2,000 acres of mining lands, which, although not now worked, are known to contain a fine grade of fluorspar.

In Illinois the fluorspar is found under the same general conditions as in Kentucky. It is also of the massive variety, but is of a mottled color and not as pure. The Fluorspar Company owns or controls extensive deposits at Karber's Ridge, Cypress Junction, and Shawneetown, in Illinois, which are worked on the same plan as in Kentucky.—E. E. Squier, Jr., in Engineering and Mining Journal.

## AGRICULTURAL UTILIZATION OF DISEASED AND PUTRID MEATS.

In 1883 M. Aimé Girard suggested an easy and advantageous process for utilizing the dead bodies of animals and rejected meats. The lamented professor advised the dissolution of the remains in sulphuric acid and the utilization of the nitrogenous product in the fabrication of superphosphates.

The process is of great utility. Every dangerous germ is destroyed by the acid of 66° Baumé which is employed for dissolving the meats and dead bodies. The nitrogen of the flesh and the phosphate of the bones are preserved and utilized.

Certain individuals availed themselves speedily of M. Girard's suggestions.

In 1884 M. Picard, manager of the estate of M. Houette at Lamothe-Jarry (Yonne), installed on his farm a working place for treating animal remains by sulphuric acid. These are thrown into vats constructed of wood with a lining of lead. In a day or two the fat alone remains, and the dissolved portion serves for the manufacture of animalized superphosphates. From 1884 to 1892 M. Picard treated more than 70,000 kilos.

In 1893 a manufacturer obtained authorization to work the Girard processes at Rouen. Here 15,000 to 20,000 kilos are treated yearly.

At Marseilles an establishment of the same kind, recently started, has treated 150,000 kilos during the first year.

Similar enterprises have been inaugurated at Beaulieu (Indre-et-Loire), at Saint Martin d'Hères near Grenoble, at Romans (Drôme) and Nantes.

Recently Mr. Lindet, Professor of Technology at the National Agricultural Institute, has prepared an interesting paper on the establishment at Geneva, also of recent foundation.

The animals, seized meats, etc., are brought in covered vehicles, which are disinfected as soon as they are unloaded. The carcasses immediately after being cut up, and even before if the animals have died of glanders or anthrax, are immersed in sulphuric acid.

The vats have a capacity of more than two square meters (1 meter deep by 2.20 meters long and 1.10 meters wide). They are constructed of spruce lined with lead 5 millimeters thick, and have on the top a wooden trough of 0.15 meter width and depth sustained by iron supports, in which the flanges of the cover sink. The cover is furnished with hinges and can be readily raised by a pulley.

The remains to be treated are put into the vat to the amount of 1,500 kilogrammes. To prevent the con-



tents from being forced to the surface by the gases, they are covered with heavy leaden slabs having holes by which they can be more readily taken out. In summer the remains are completely dissolved in twenty-four hours. The animalized sulphuric acid, after being freed from the fat floating on the surface by means of a siphon, can be conveyed through an underground conduit to the superphosphate factory.

The germs of contagious diseases or pathogenic microbes are certainly destroyed. With reference to the remains of animals that have died of anthrax, tuberculosis, measles, etc., it is proved beyond question that the bacilli of these maladies are destroyed by the sulphuric acid.

From the industrial view-point, the preparation of the animalized phosphates is lucrative, and the operator has also the profit from the sale of the fats, skins, horns, hoofs, etc.

From the sanitary view-point, the removal of the dead bodies or remains and the destruction of injurious germs are assured.

From the agricultural view-point, the process is valuable in utilizing available fertilizing materials previously lost.—From the French of D. Zolla in *Le Phosphate*.

#### PROBABLE ORIGIN OF CONTINENTS AND OCEAN DEPTHS.\*

If the shoaling of the lava ocean up to the surface had taken place everywhere at the same time, the whole surface of the consistent solid would be the dead level of the liquid lava all round, just before its depth became zero. On this supposition there seems no possibility that our present day continents would have risen to their present heights, and that the surface of the solid in its other parts could have sunk down to their present ocean depths, during the twenty or twenty-five million years which may have passed since the consistent status began or during any time however long. Rejecting the extremely improbable hypothesis that the continents were built up of meteoric matter tossed from without, upon the already solidified earth, we have no other possible alternative than that they are due to heterogeneity in different parts of the liquid which constituted the earth before its solidification.

The hydrostatic equilibrium of the rotating liquid involved only homogeneity in respect to density over every level surface (that is to say, surface perpendicular to the resultant of gravity and centrifugal force); it required no homogeneity in respect to chemical composition. Considering the almost certain truth that the earth was built up of meteorites falling together, we may follow in imagination the whole process of shrinking from gaseous nebula to liquid lava and metals, and solidification of liquid from central regions outward, without finding any thorough mixing up of different ingredients, coming together from different directions of space—any mixing up so thorough as to produce even approximately chemical homogeneity throughout every layer of equal density. Thus we have no difficulty in understanding how even the gaseous nebula, which at one time constituted the matter of our present earth, had in itself a heterogeneity from which followed by dynamical necessity Europe, Asia, Africa, America, Australia, Greenland and the Antarctic Continent, and the Pacific, Atlantic, Indian and Arctic Ocean depths, as we know them at present.

We may reasonably believe that a very slight degree of chemical heterogeneity could cause great differences in the heaviness of the snow shower of granules and crystals on different regions of the bottom of the lava ocean when still fifty or one hundred kilometers deep.

Thus we can quite see how it may have shoaled much more rapidly in some places than in others. It is also interesting to consider that the solid granules, falling on the bottom, may have been largely disturbed, blown as it were into ridges (like rippled sand in the bed of a flowing stream, or like dry sand blown into dunes and hills by wind) by the eastward horizontal motion which liquid descending in the equatorial regions must acquire, relatively to the bottom, in virtue of the earth's rotation. It is, indeed, not improbable that this influence may have been largely effective in producing the general configuration of the great ridges of the Andes and Rocky Mountains and of the west coast of Europe and Africa. It seems, however, certain that the main determining cause of the continents and ocean depths was chemical differences, perhaps very slight differences, of the material in different parts of the great lava ocean before consolidation.

#### NITROGENOUS FOOD OF PLANTS.

ACCORDING to experiments carried on by M. L. Lutz, it is possible for flowering plants, when placed in aseptic conditions, to take the nitrogen necessary for their sustenance from organic compounds belonging to the class of amines in the form of salts. The assimilation of these substances may take place without their nitrogen having been first transformed into nitric or ammoniacal nitrogen. Ammoniacal salts composed of alkaloids cannot supply to plants their necessary nitrogen. Algae placed in similar aseptic conditions present the same phenomena as flowering plants. Fungi have the power also of deriving their nitrogen from amines, as well as from nitric or ammoniacal nitrogen. With them, in regard both to amines and to alkaloids, the intensity of assimilation is in inverse proportion to the size of the molecules.—*Ann. Sci. Nat. (Bot.)*, 7, 1899, p. 1.

The large lift on the Dortmund and Ems Canal in Germany, capable of raising or lowering 600-ton barges, is controlled by electric motors. The lift is counterbalanced and operated by the addition of sufficient water to lower it, which is withdrawn when the lift is to be raised. The motion is governed by four enormous steel screws 81 feet long by 11 inches in diameter, which are rotated by electric motors. Other motors control the gates and drive the pumps.—*American Electrician*.

\* From an address by Lord Kelvin, in Science.

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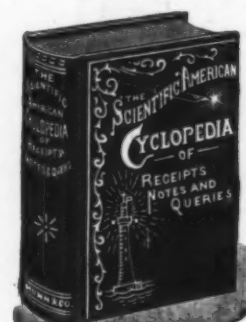
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#### TABLE OF CONTENTS.

	PAGE
I. ARMY LIFE.—The Training of a Modern Cavalryman.—1 Illustration.....	19746
II. BOTANY.—Nitrogenous Food of Plants.....	19756
III. CERAMICS.—Pottery as a Historical Document.—3 Illustrations.....	19754
IV. COMMERCE.—Trade Suggestions from United States Consuls.....	19748
V. ELECTRICITY.—Methods of Determining the Frequency of Alternating Currents.—By CARL KINSEY.—6 Illustrations.....	19756
VI. FERTILIZERS.—Agricultural Utilization of Diseased and Putrid Meats.....	19750
VII. FUELS.—Smoke Consumption and Economy of Fuel.....	19753
VIII. GEOLOGY.—Probable Origin of Continents and Ocean Depths.....	19756
IX. MARINE ENGINEERING.—Ships Building for the British Navy.—1 Illustration.....	19754
X. MECHANICAL ENGINEERING.—Elevators.—By CHARLES R. PRATT.—8 Illustrations.....	19745
Castings.—By JOHN M. RICHARDSON.....	19752
Reduction of Sulphur Ore in Sicily.....	19753
XI. MEDICINE.—Mental Fatigue.....	19745
XII. MINING.—Fluorspar Mining.....	19757
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